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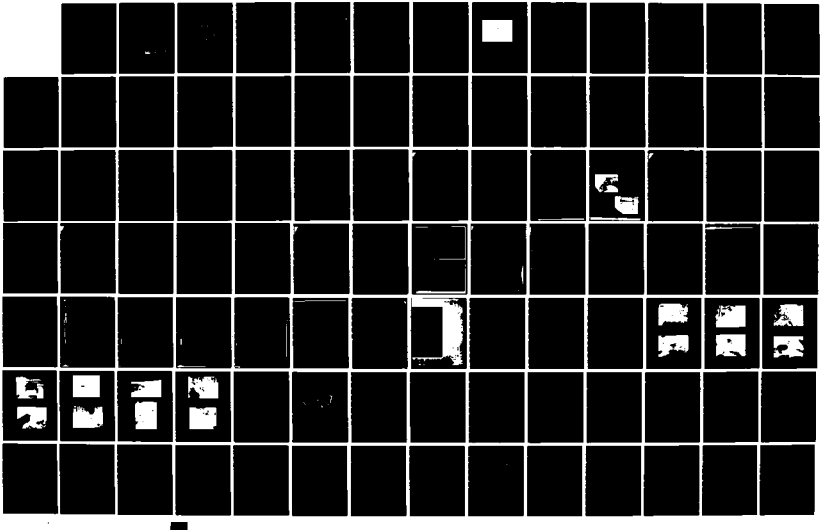

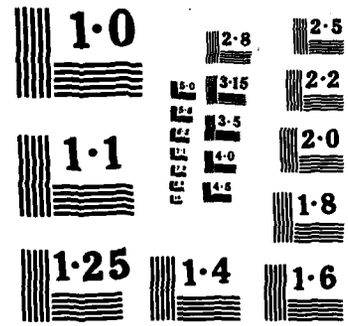

NATIONAL BUREAU OF STANDARDS
MICROCOPY RESOLUTION TEST CHART

MERRIMACK RIVER BASIN

BELMONT, NEW HAMPSHIRE

SARGENT LAKE DAM
N.H. 00086

STATE NO. 21.03

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

NOVEMBER 1979

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

DAMS, INSPECTION, DAM SAFETY,

Merrimack River Basin
Belmont, New Hampshire
Badger Brook

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The dam is an earthen embankment dam with a hydraulic height of 14 ft. and 422 ft. long. The dam is on poor condition. There are a few major concerns which must be corrected to assure the continued performance of the dam. It is small in size with a high hazard classification. The test flood may range from ½ to the Probable Maximum Flood. The PMF was selected as the test flood because of the potential for loss of life and poor condition of the dam.

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NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT

Identification No.: NH00086
Name of Dam: Sargent Lake Dam
Town or City: Belmont
County and State: Belknap County, New Hampshire
Stream or River: Badger Brook
Date of Inspection: September 7, 1979

BRIEF ASSESSMENT

Sargent Lake Dam is an earthen embankment dam with a hydraulic height of 14 feet, is 6 to 13 feet wide, and is 422 feet long. The principal spillway consists of a concrete capped, dry stone masonry section about 49 feet in length. A stoplog opening 2 feet long is located in the northeastern section of the principal spillway. The dam spans a reach of Badger Brook, and is located in central New Hampshire. Maximum storage capacity is 440 acre-feet. Sargent Lake Dam is used for recreation. The pond is 2,290 feet in length with a surface area of about 55 acres at principal spillway crest.

The dam is in poor condition. Major concerns are: an inadequate spillway, three seepages, growth of trees on embankments, poor quality of concrete capping, potential for erosion of a 23-foot wide strip in an area on the crest lower than the principal spillway abutments in case of overtopping and an inoperable low-level gate.

The dam is of small size and high hazard classification based on storage volume and potential for loss of 10-15 lives and extensive property damage in event of a breach. In accordance with Corps guidelines, the test flood may range from ½ to the Probable Maximum Flood (PMF). The PMF was selected as the test flood because of the potential for loss of life and poor condition of the dam. Sargent Lake receives a test flood inflow of 6,200 cfs from a 2.8 square mile drainage area resulting from the routed PMF outflow from Sawyer Lake Dam (2,900 cfs) plus the flow from the intervening drainage area (3,300 cfs) determined by use of the Corps' guide curve for mountainous terrain. After routing, to determine the modifying effect of surcharge storage, the test flood outflow was determined to be 5,850 cfs (2,090 csm) at elevation 771.4' MSL. The test flood analysis indicates the dam would be overtopped by 5.5 feet (6.9 feet over principal spillway crest). Assuming a water surface at top of dam, the spillway will pass 187 cfs (with stoplogs) and 199 cfs (stoplogs removed) or about 3 percent of the routed test flood outflow. Therefore, the spillway is considered inadequate.

The owner, Sargent Lake Association, should implement the results of the recommendations and remedial measures given in Sections 7.2 and 7.3 within one year after receipt of this Phase I Inspection Report.

Warren A. Guinan
Project Manager
N.H. P.E. 2339

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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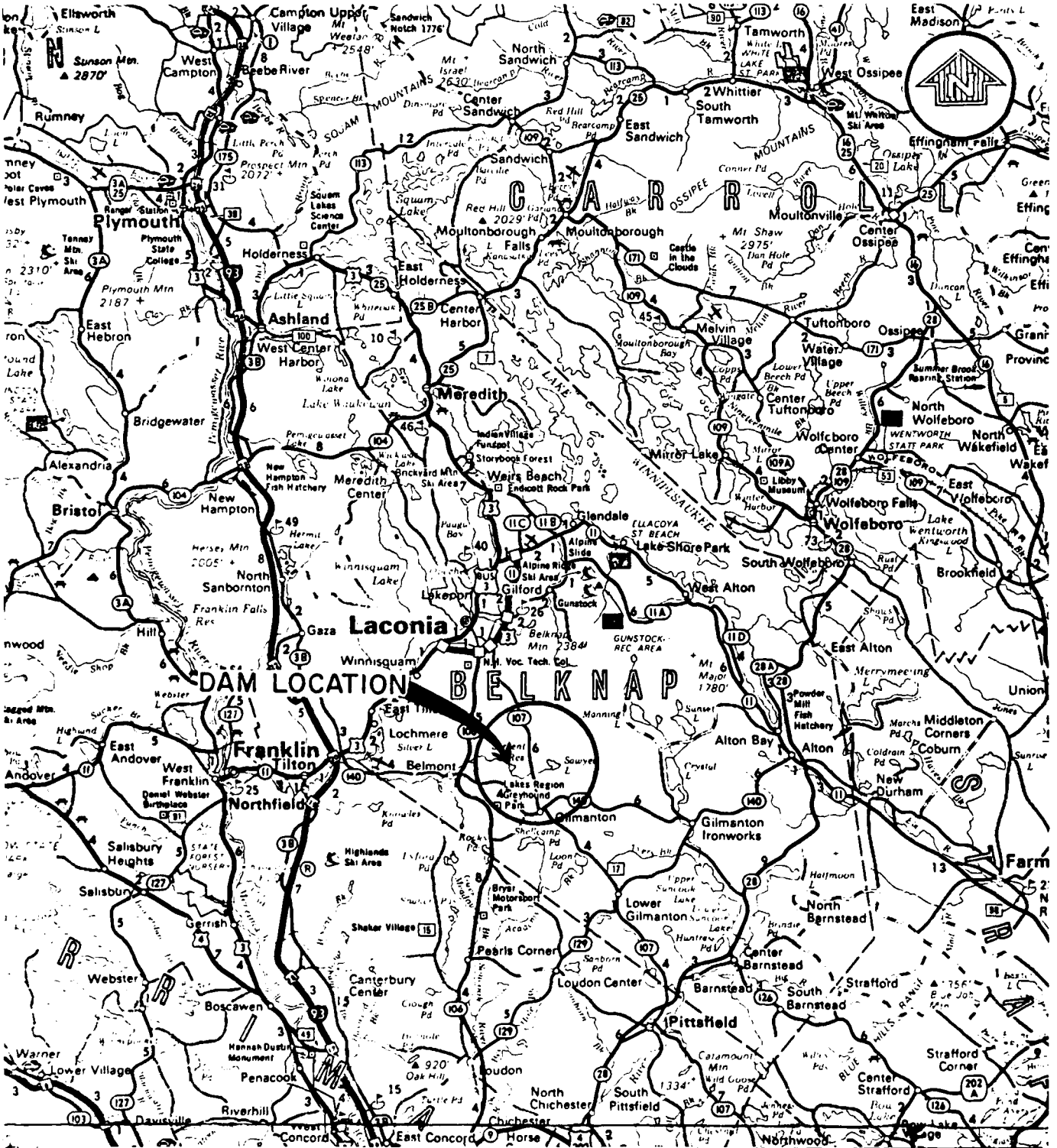
October 4, 1979
Figure 1 - Overview of Sargent Lake Dam.



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SCALE IN MILES

0 5 10

MAP BASED ON STATE OF NEW HAMPSHIRE OFFICIAL HIGHWAY MAP

Anderson-Nichols & Co, Inc. CONCORD NEW HAMPSHIRE	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

SARGENT LAKE DAM
LOCATION MAP

BADGER BROOK NEW HAMPSHIRE

SCALE:	SEE BAR SCALE
DATE:	NOVEMBER 1979

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT
SARGENT LAKE DAM

SECTION 1
PROJECT INFORMATION

1.1 General

a. Authority. Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Anderson-Nichols & Company, Inc. has been retained by the New England Division to inspect and report on selected dams in the State of New Hampshire. Authorization and notice to proceed were issued to Anderson-Nichols & Company, Inc. under a letter of March 22, 1979 from John P. Chandler, Colonel, Corps of Engineers. Contract No. DACW33-79-C-0050, as changed, has been assigned by the Corps of Engineers for this work.

b. Purpose

(1) To perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

(2) To encourage and prepare the states to initiate quickly effective dam safety programs for non-Federal dams.

(3) To update, verify, and complete the National Inventory of Dams.

1.2 Description of Project

a. Location. Sargent Lake Dam is located in the Town of Belmont, New Hampshire and spans Badger Brook. After discharging over the dam, Badger Brook flows westerly a distance of 1.7 miles into Badger Pond. The Tioga River begins at the outlet of Badger Pond and flows for a distance of about 4 miles to its confluence with the Winnipesaukee River, a major tributary in the Merrimack River Basin. Sargent Lake Dam is shown on U.S.G.S. 15 Minute Quadrangle, Gilmanton, New Hampshire with coordinates approximately at W 71° 26' 18" and N 43° 27' 06", Belknap County, New Hampshire. (See Location Map Page vii.)

b. Description of Dam and Appurtenances. Sargent Lake Dam is an earthen embankment dam about 422 feet in length, with a hydraulic height of 14 feet, and a width ranging from 6 to 13 feet. The upstream and downstream faces are covered with trees and brush and have a slope of 2H:1V. From northeast to southwest, the dam consists of an earthen embankment 120 feet long with a width of 13 feet, a concrete capped dry stone masonry principal spillway 49 feet long with a stoplog opening 2 feet long which is controlled by stoplogs and is located on the northeastern section of the principal spillway, a dry stone masonry section 40 feet long, and an earthen embankment section about 253 feet long. A gate manhole 3 feet in diameter is located atop the northeastern section of the principal spillway. The gate operating mechanism once operated a 2 foot high by 3.5 foot wide low-level outlet. The gate is inoperable at the present time.

c. Size Classification. Small (hydraulic height - 14 feet; storage - 440 acre-feet) based on storage ($\geq$ 50 to $<$ 1000 acre-feet) as given in the Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification. High hazard. A major breach would probably result in the loss of 10-15 lives and cause extensive property damage. (See Section 5.1 f.)

e. Ownership. The Sargent Lake Dam was originally owned by the Belmont Mills. Ownership was transferred to the Belmont Hosiery Company and later to George and Ida Curley followed by Arnold Dane - Julia Flagerty - Bertram Dane - and Paramount Realty, Inc. In 1973 the New Hampshire Superior Court transferred ownership to the Sargent Lake Association, the current owner.

f. Operator. The current operator of the Sargent Lake Dam is the Sargent Lake Association, P.O. Box 22, Belmont, New Hampshire 03220. Mrs. John Janerico is the current president of Sargent Lake Association.

g. Purpose of Dam. The original purpose for the construction of Sargent Lake Dam was not disclosed. Around 1934-1938 it was used as industrial water storage for use in milling operations in Belmont. Currently it is used only for recreation.

h. Design and Construction History. No information was found regarding the original design and construction of the dam. The dam appears to have been built about one hundred years ago. In 1935, some planks that were worn out were replaced by Arthur Prebley (engineer) of Milton, New Hampshire. Plans of the repair are available in the files of the New Hampshire Water Resources Board (NHWRB). In January, 1938, the earth embankment breached inundating State Highway 106 to a depth of 2 feet immediately downstream of Badger Pond. Badger Pond Dam was not damaged at that time. The embankment was replaced with a timber crib dam by H.M. Bryant (engineer) of Milton, New Hampshire. Extensive repairs were done in 1974 consisting of concrete upstream facing and concrete replacement spillway. The stone masonry section of the southwest abutment was recapped in 1978.

i. Normal Operating Procedures. No written operational procedures were found for Sargent Lake Dam. The gate in the manhole is inoperable. All of the stoplogs are removed once a year around October to reduce the water surface elevation to the stoplog opening crest providing storage for spring runoff.

1.3 Pertinent Data

a. Drainage Area. The drainage area consists of 2.8 square miles (1,792 acres) of rolling and mountainous, mostly forested terrain. The normal pool has a surface area of 55 acres, which constitutes 3 percent of the watershed.

b. Discharge at Damsite

(1) Outlet works - one gate opening (2'H x 3.5'W) at the northeastern end of the principal spillway, invert elevation 752.2' MSL. The gate is not operable.

(2) The maximum discharge at the damsite is unknown.

(3) Ungated spillway capacity at top of dam - not applicable

(4) Ungated spillway capacity at test flood elevation - not applicable

(5) Gated spillway capacity at top of dam elevation - with stoplogs:

Stoplog opening - 20 cfs at 765.9' MSL
Principal spillway - 167 cfs at 765.9' MSL

without stoplogs:

Stoplog opening - 32 cfs at 765.9' MSL
Principal spillway - 167 cfs at 765.9' MSL

(6) Gated spillway capacity at test flood elevation - with stoplogs:

Stoplog opening - 145 cfs at 771.4' MSL
Principal spillway - 2,200 cfs at 771.4' MSL

(7) Total spillway capacity at test flood elevation - with stoplogs - 2,345 cfs at 771.4' MSL

(8) Total project discharge at test flood elevation - 5,850 cfs at 771.4' MSL

c. Elevation. (Feet above NGVD of 1929, formerly called Mean Sea Level Datum (MSL); elevations are relative to assumed northeast abutment elevation of 769' MSL.)

(1) Streambed at centerline of dam - 752.2 (downstream toe)

(2) Maximum tailwater - unknown

(3) Northeast gate opening invert - 752.2

(4) Stoplog opening crest (with stoplogs) - 763.9

(5) Stoplog opening invert (without stoplogs) - 762.6

(6) Principal spillway crest - 764.7

(7) Top of dam - 765.9 (low point roadway on crest)

(8) Test flood pool - 771.4

d. Reservoir (feet)

(1) Length of maximum pool - 2,370

(2) Length of pool at spillway crest - 2,290

(3) Length of flood control pool - not applicable

e. Storage (acre-feet)

(1) Recreation pool - 360 (approximate)

(2) Flood control pool - not applicable

(3) Principal spillway crest pool - 360 (approximate)

(4) Top of dam pool - 440 (approximate)

(5) Test flood pool - 810 (approximate)

f. Reservoir Surface (acres)

(1) Recreation pool - 55 (approximate)

(2) Flood control pool - not applicable

(3) Principal spillway crest pool - 55 (approximate)

(4) Top of dam pool - 66 (approximate)

(5) Test flood pool - 70 (approximate)

g. Dam

(1) Type - earthen embankment

(2) Length - 422'

(5) Engage a Registered Professional Engineer to make a comprehensive technical inspection once every year after the recommendations made in 7.2 above have been carried out.

(6) Establish a surveillance program for use during and immediately after heavy rainfall and also a downstream warning program to follow in case of emergency conditions.

7.4 Alternatives

None, if the recreational aspects of the dam and reservoir are deemed to be desirable and necessary.

7.2 Recommendations

The owner should engage a qualified registered engineer to:

(1) Conduct a detailed hydrologic analysis of the spillway adequacy and to increase spillway capacity if the analysis so indicates.

(2) Design repairs for and supervise filling the low section of the road on southwest embankment to prevent the embankment from being overtopped before the full principal spillway capacity is utilized.

(3) Investigate the seepage at the downstream toe of the principal spillway section and downstream of the northeast embankment section and design appropriate remedial measures.

(4) Design appropriate repairs for the concrete capping of the principal spillway and dry stone-masonry sections.

(5) Design a permanent system for reducing seepage through the dry stone-masonry section to replace the polyethylene sheet now being used.

(6) Design procedures for clearing trees and brush and their root systems from the dam and the area immediately downstream of the toe of the dam, and for properly back-filling the areas where the roots are removed.

(7) Design appropriate repairs to the low-level outlet gate and operating mechanism.

The owner should carry out the recommendations made by the engineer.

7.3 Remedial Measures

a. Operating and Maintenance Procedures. The owner should:

(1) Remove the stoplogs until the recommendations are implemented.

(2) Monitor the seepages until repairs recommended above have been effected.

(3) Maintain clear of trees the brush: (a) the dam embankment, (b) an area within 25 feet of the downstream toe of the dam, and (c) a zone 25 feet wide on either side of the downstream channel for a distance of 100 feet downstream from the dam or to the limits of the property, whichever is less.

(4) Visually inspect the dam and appurtenant structures once a month.

SECTION 7
ASSESSMENT, RECOMMENDATIONS, AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. The visual examination indicates that Sargent Lake Dam is in poor condition. The major concerns with respect to the integrity of the dam are:

(1) Inadequacy of the spillway.

(2) Seepage and piping at the toe of the overflow-spillway section of the dam.

(3) Possible seepage associated with a wet area about 25 feet downstream from the northeast embankment section.

(4) Use of polyethylene sheet on the upstream slope of the dry stone-masonry section to reduce leakage.

(5) Growth of trees and brush on the embankment sections and downstream of the dam.

(6) Poor quality of the concrete capping on the dry stone-masonry section of the dam.

(7) Potential erosion of a 23-foot wide strip bare of vegetation, from the crest to the downstream toe of the southwest embankment section, and the low point in the dam crest in case of overtopping.

(8) Lack of an operable gate to utilize the low-level outlet to drain the lake in event of emergency.

b. Adequacy of Information. The information available is such that the assessment of this dam must be based primarily on the results of the visual inspection. The presence of trees and brush on many areas of the dam makes it impossible to inspect those areas adequately.

c. Urgency. The owner should carry out the recommendations made in 7.2 and 7.3 within one year after receipt of this Phase I report.

d. Need for Additional Investigation. Additional studies of hydrology and hydraulics are needed to determine an adequately sized spillway. Areas that are now covered with trees and brush should be inspected after the trees and brush are cleared.

c. Operating Records. Available documentation indicates that the dam was breached in February 1938 and that State Highway 106, which is downstream of Badger Pond, was inundated by 2 feet of water as a result.

d. Post-Construction Changes. Available documentation indicates that the dam underwent major repairs in 1935, 1938, 1974, and 1978. One document indicates that the 1978 repairs included "grouting".

e. Seismic Stability. This dam is located in Seismic Zone 2 and, in accordance with the Phase I guidelines, does not warrant seismic analysis.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations. The visual examination indicates that several potential problems exist which are discussed in the following paragraphs.

(1) A seepage at the top of the overflow spillway section shows evidence of piping of sand, the origin of which may be an underwater earth berm against the upstream side of the spillway. The leakage and piping could lead to significant structural damage if not corrected.

(2) The poor quality of the concrete capping and the use of polyethylene sheet underwater on the upstream slope of the dry-stone-masonry section of the dam to reduce leakage are, at best, temporary measures and must be replaced by a more-permanent type of construction to ensure the long-term stability of the dam.

(3) A 23-foot-wide strip, bare of vegetation, from the crest to the downstream toe of the southwest embankment section next to the dry-stone-masonry section would be very susceptible to erosion if the dam should be overtopped. This section contains the low point in the dam crest which is lower than the top of the principal spillway aubtments. This deficiency should be corrected as soon as possible.

(4) Growth of trees and brush is very dense on the southwest embankment section. Moderate growth of trees has developed on the upstream and downstream slopes of the northeast embankment section and in the area immediately downstream of the dam. If a tree blows over and pulls out its roots or if a tree dies and its roots rot, serious seepage and erosion problems could result.

(5) A wet area about 25 feet downstream of the northeast embankment section may be a sign of a seepage problem, or it may be only the result of natural groundwater discharge from the side of the downstream valley.

b. Design and Construction Data. Little design and construction data are available. (See Section 1.2 h.).

Hurricane Road culvert 4,100 feet D/S of Badger Pond Dam - An increase in stage of 14.3 feet due to breach of Sargent Lake Dam would result. The culvert consists of a corrugated metal pipe arch with a span of 18.5 feet and a rise of 12.5 feet. The following inhabited structures would be severely damaged by the breach:

Structure	Type	Elev. Above Normal Water Surface Elev.	Comment
1	House	10.3'	Inundated
2	House	11.6'	Inundated
3	House	13.3'	Inundated
4	House	14.5'	Inundated
5	House	6.5'	Inundated
6	Church	9.3'	Inundated
7	Laundry	8.8'	Inundated

Section from 4,100 feet to 5,100 feet D/S of Badger Pond Dam - An increase in stage of 9.6 feet due to breach of Sargent Lake Dam would result. There are no inhabited structures in this reach.

State Route 140, 5,100 feet D/S of Badger Pond - An increase in stage of 8.7 feet due to breach of Sargent Lake Dam would result. The State Route 140 structure consists of a 12'H x 32'W box culvert. The road would not be overtopped. The mobile home with elevation of 509.9' MSL (6.4 feet above normal water surface elevation) just D/S of the State Route 140 would be severely damaged.

A breach would result in the loss of 10 to 15 lives and extensive property damage to the four road crossings and 9 houses located downstream, resulting in a high hazard classification.

point of the road on southwest embankment, elevation 765.9' MSL) was properly filled and graded to the southwest stone-masonry abutment level (elevation 766.5' MSL), the full discharge capacity of the principal spillway (335 cfs) would be utilized.

f. Dam Failure Analysis. The impact of failure of the dam at normal pool (principal spillway crest) was assessed using the Guidance for Estimating Downstream Dam Failure Hydrographs issued by the Corps of Engineers. The analysis covered the reach extending from Sargent Lake Dam to State Route 140, 2.7 miles downstream of Badger Pond.

A breach at principal spillway crest would result in a discharge of 7,680 cfs into the downstream channel. The antecedent discharge prior to a breach would be 5 cfs with stoplogs in place. The breach discharge would affect the downstream area as follows:

Section from Sargent Lake Dam to 100' D/S - An increase in stage of 9.8 feet due to breach would result. There are no inhabited structures in this reach.

Sargent Lake Road culvert crossing 100 feet D/S of Sargent Lake Dam - An increase in stage of 14.6 due to breach would result. The structure consists of a 4-foot pipe. Sargent Lake Road would be overtopped by 8.5 feet, probably causing severe damage to the road.

Section from Sargent Lake Road culvert to 1.7 miles D/S of Sargent Lake Dam - An increase in stage of 10.5 feet due to breach would result. There are no inhabited structures in this reach.

Badger Pond Dam - An increase in stage of 7.7 feet due to breach of Sargent Lake Dam would result in Badger Pond causing the Badger Pond Dam to be overtopped by 1.7 feet, probably resulting in serious erosion of the earthen abutments.

Section from Badger Pond Dam to 600 feet D/S - An increase in stage of 10.5 feet due to breach of Sargent Lake Dam would result. There are no inhabited structures in this reach.

State Route 106 culvert crossing 600 feet D/S of Badger Pond Dam - An increase in stage of 14.1 feet due to breach of Sargent Lake Dam would result, causing the road to be overtopped by 4.1 feet. The structure consists of a 6'H x 30'W box culvert.

Section from 600 feet to 4,100 feet D/S of Badger Pond Dam - An increase in stage of 12.3 feet due to breach of Sargent Lake Dam would result. The house just D/S of the State Route 106 with elevation of 559.1' MSL (8.1 feet above normal water surface elevation) would be severely damaged.

SECTION 5
HYDROLOGIC/HYDRAULIC

5.1 Evaluation of Features

a. General. Sargent Lake Dam is an earthen embankment which impounds a reservoir of small size. The low-level outlet, which extends through the base of the dam, has been made inoperable by removal of gate mechanism. A sand and gravel road runs to the top of the dam and may be susceptible to erosion if overtopped. A low section on this road presently is top of dam. The road would become overtopped before full spillway capacity is reached. The reservoir level is controlled by stoplogs in the stoplog opening which is located on the northeastern end of the principal spillway. The watershed consists of 2.8 square miles of mountainous terrain. Sawyer Lake is present in the upstream watershed. Discharge at Sargent Lake Dam continues Badger Brook.

b. Design Data. No original hydrologic or hydraulic design data were found.

c. Experience Data. The known flood of record occurred in March 1936. In February 1938 the earthen embankment was washed off, inundating State Route 106 to a depth of 2 feet just downstream of Badger Pond. The embankment was repaired later. The dam was renovated in 1974.

d. Visual Observation. At the time of inspection, no visual evidence was noted of damage to the dam caused by excessive discharges.

e. Test Flood Analysis. Sargent Lake Dam is classified as being small in size having a hydraulic height of 14 feet and a maximum storage capacity of 440 acre-feet; the dam was determined to have a High Hazard classification. Using the Recommended Guidelines for Safety Inspection of Dams, the test flood ranges from ½ Probable Maximum Flood (PMF) to the full PMF. Due to the poor condition of the dam and the potential for loss of life, the full PMF was selected as the test flood. The test flood inflow for Sargent Lake Dam, having a drainage area of 2.8 square miles, was determined to be 6,200 cfs resulting from the routed outflow from Sawyer Lake Dam (2,900 cfs) plus the flow from the remaining drainage area (3,300 cfs) as determined by use of the Corps' guide curve for mountainous terrain. The test flood outflow after routing was calculated to be 5,850 cfs at elevation 771.4' MSL. The test flood analysis indicates that the dam embankment would be overtopped by approximately 5.5 feet during test flood conditions (6.9 feet over principal spillway crest). The maximum spillway capacity at top of dam is 187 cfs with stoplogs and 199 cfs without stoplogs, which is only 3 percent of the routed test flood outflow. The capacity of the spillway is inadequate to pass the test flood. Until such time as the adequacy of the spillway can be evaluated further, removal of 2 feet of stoplogs should be considered to provide some surcharge storage. If the present top of dam (low

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures

No written operational procedures exist for Sargent Lake Dam. All of the stoplogs are removed once a year around October to reduce the lake level. The gate is inoperable.

4.2 Maintenance of Dam

The owner, Sargent Lake Association, is responsible for the maintenance of the dam.

4.3 Maintenance of Operating Facilities

Maintenance of operating facilities is limited to the removal of all stoplogs in October and replacing them in the spring.

4.4 Description of any Warning System in Effect

No written warning system exists for the dam.

4.5 .valuation

The current operational procedures are not adequate to ensure that problems encountered can be remedied within a reasonable amount of time.

e. Downstream Channel. The channel bottom consists of sand, gravel, and boulders. Trees and brush overhang the channel. The channel crosses the Sargent Lake Road (dirt road) and travels about 1.7 miles through the woods to discharge into Badger Pond. (See Appendix C - Figures 13, 14 & 15.)

3.2 Evaluation

Based on the visual inspection, Sargent Lake Dam is in poor condition.

A seepage at the toe of the principal spillway section shows possible evidence of piping of sand, however, the origin of the sand may be an underwater earth berm against the upstream side of the spillway. The leakage and possible piping could lead to significant structural damage if not corrected.

The poor quality of the concrete capping and the use of polyethylene sheet underwater on the upstream slope of the dry stone-masonry section of the dam to reduce leakage are, at best, temporary measures and must be replaced by a more permanent-type of construction to ensure the long-term stability of the dam.

A 23-foot wide strip, bare of vegetation, from the crest to the downstream toe of the southwest embankment section next to the dry stone-masonry section would be very susceptible to erosion if the dam should be overtopped.

A very dense growth of trees and brush has developed on the southwest embankment section. A moderate growth of trees has developed on the upstream and downstream slopes of the northeast embankment section and immediately downstream of the northeast embankment section, the embankment and dry stone-masonry section, and the dry stone-masonry section. If a tree blows over and pulls out its roots or if a tree dies and its roots rot, serious seepage and erosion problems could result. Trees and brush growing in the downstream channel and on the banks of the channel will partially obstruct flow in the channel during periods of high flow, and if trees fall over into the channel they may obstruct flow in both the channel itself and in culverts downstream.

A wet area about 25 feet downstream of the northeast embankment section may be a sign of a seepage problem, or it may be only the result of natural groundwater discharge from the side of the downstream valley.

The extensive growth of trees and brush, and a pile of logs, stumps, and other debris at the downstream toe of the dam near the northeast abutment makes it impossible to adequately inspect the dam in this area.

The principal spillway section is capped with concrete which is in fair condition. (See Appendix C - Figure 5.) The concrete is very rough and surface erosion has exposed the coarse aggregate. Some spalling was noted where steel members are embedded in the concrete and some chipping of the concrete was noted at the weir crest. The dry stone-masonry which constitutes the downstream face is in fair condition and shows no signs of distress. Mr. John Janerico reported that some grouting of the dry stone-masonry was carried out in 1978. To the extent that it can be seen beneath the lake surface, it appears that earthfill has been placed against the upstream side of this section. Near the northeast end of the section a small earthfill has been placed to an elevation above lake level, reportedly for the purpose of stopping leakage around the low-level outlet. (See Appendix C - Figure 6.) A stoplog opening 2 feet wide and with a bottom elevation 2.1 feet below the principal spillway crest is located near the northeast end. (See Appendix C - Figures 7 & 8.) The stoplogs are 1½ inches thick and consist of treated wood. The steel angle supports were observed to be surface corroded. A leak of clear water estimated to be 5-20 gpm, is discharging at the base near the middle of the downstream dry stone-masonry section. Sand which probably has been washed away when water discharges over the principal spillway, has accumulated at the location where the leak is discharging; however, this sand may be evidence of piping of material. Because available documents indicate that the dam is founded on bedrock, this material is more logically coming from the earth berm that has been placed against the upstream side of the principal spillway.

The dry stone-masonry section has a recently placed, crude concrete cap and concrete facing on the inclined upstream face. (See Appendix C - Figures 9 & 10.) It appears that there is an inclined earth slope below water level on which a polyethylene sheet has been placed to reduce leakage. Trees are growing at the downstream toe of this section.

The southwest embankment section is covered with a very dense growth of trees and brush on the crest and on the upstream and downstream slopes. However, near the dry stone-masonry section, there is a strip about 15 feet from the crest to the toe of the downstream slope which is bare of vegetation. (See Appendix C - Figure 11.)

c. Appurtenant Structures. Adjacent to the northeast end of the principal spillway there is a 3-foot diameter concrete manhole with a concrete cover. It has been reported that the manhole is set over the now inoperable low-level gate. The concrete chamber was observed to be in good condition. The low-level outlet gate was not visible because of water in the bottom of the chamber.

d. Reservoir Area. The watershed above the lake is moderately to steeply sloping and heavily wooded. (See Appendix C - Figure 12.) There are many camps on the lake. No evidence of significant sedimentation was observed.

SECTION 3
VISUAL INSPECTION

3.1 Findings

a. General. Sargent Lake Dam is a low dam which impounds a reservoir of small size. The watershed above the reservoir is moderately to steeply sloping and heavily wooded. Badger Pond is about 1.7 miles downstream and the Town of Belmont is about 2½ miles downstream.

b. Dam. Sargent Lake Dam has a hydraulic height of 14 feet and is 422 feet long. It consists of five sections (see Appendix D, D-35) which are, from the northeast abutment to the southwest abutment: (1) an earthen embankment, about 13 feet wide at the crest and 96 feet long, with a central concrete (or possibly concrete-capped stone masonry) core wall, earthen upstream and downstream slopes inclined at 2H:1V, and riprap on the upstream slope; (2) an earthen embankment, about 13 feet wide at the crest and 24 feet long, with a concrete-capped, vertical dry-stone-masonry wall on the downstream side, a vertical concrete (or concrete-capped dry-stone-masonry) wall on the upstream edge of the crest and a riprapped earth berm against the upstream side of the wall; (3) a concrete-capped dry-stone-masonry overflow section about 49 feet long and with an inclined crest about 10.7 feet wide and inclined downstream at a slope of 20H:1V; the overflow section consists of a 47-foot long pricnipal spillway (elevation 764.7' MSL) and a 2-foot long stoplog opening with invert elevation of stoplogs at 762.6' MSL; (4) a dry-stone-masonry section about 40 feet long with a crudely placed concrete cap; and (5) an embankment section about 253 feet long with earthen upstream and downstream slopes inclined at 2H:1V. These sections are referred to below as the (1) northeast embankment section, (2) embankment and stone-masonry section, (3) principal spillway, (4) dry-stone-masonry section, and (5) southwestern embankment section.

Trees are growing on the upstream and downstream slopes of the northeast embankment section. (See Appendix C - Figure 2.) Riprap on the upstream slope is in generally good condition, except that trees and brush are growing through it locally. (See Appendix C - Figure 3.) The crest is covered with grassy vegetation. Trees are growing in the area downstream of the toe of the dam. (See Appendix C - Figure 4.) A single wet area was noted about 25 feet downstream of the embankment section. It may be the result of seepage through and under the dam, or it may be the result of discharge of groundwater from the valley sides downstream of the dam. Logs, stumps, and brush which have been dumped along the downstream toe make it impossible to adequately inspect this section.

The embankment and dry-masonry section has grassy vegetation on the crest. Trees are growing in the berm against the wall on the upstream edge of the crest and in the area immediately downstream of the dam.

SECTION 2
ENGINEERING DATA

2.1 Design

No original design data were disclosed for Sargent Lake Dam.

2.2 Construction

No construction data are available prior to 1935. Minor repairs were done by Arthur Preble in 1935. Extensive repairs were done in 1938 and 1974. (See Section 1.2.h.)

2.3 Operation

No engineering operational data were disclosed.

2.4 Evaluation

a. Availability. Little engineering data are available for Sargent Lake Dam. A search of the files of the New Hampshire Water Resources Board (NHWRB) and contact with a member of the Sargent Lake Association revealed only a limited amount of useful recorded information.

b. Adequacy. Because of the limited amount of detailed data available, the final assessments and recommendations of this investigation are based on the visual inspection and hydrologic and hydraulic calculations.

c. Validity. Rehabilitation plans found in the files of NHWRB are in general conformity with the structure as seen in the visual inspection.

(3) Height - 20' (structural height)

(4) Top width - varied (6' to 13')

(5) Side slopes:

Upstream: 2H:1V
Downstream: 2H:1V

(6) Zoning - unknown

(7) Impervious core - unknown

(8) Cutoff - unknown

(9) Grout curtain - unknown

h. Diversion and Regulating Tunnel - not applicable (See j. below)

i. Spillway

(1) Type - split stone with concrete capping upstream

(2) Principal spillway - 47 feet
Stoplog opening - 2 feet

(3) Crest elevation:

Stoplog opening - 763.9' MSL (stoplogs in)
- 762.6' MSL (stoplogs removed)
Principal spillway - 764.7' MSL

(4) Gates - stoplogs

(5) Upstream channel - Sargent Lake. The banks are tree-lined with houses around the lake.

(6) Downstream channel - The channel immediately downstream of the dam is approximately 10 feet wide with overbank slope of 10H:1V. Channel overbanks are covered with grass and trees. Sargent Lake Road crosses the channel 100 feet downstream of the dam. Badger Brook travels 1.7 miles through wooded uninhabited area before discharging into Badger Pond.

j. Regulating Outlets. A 2'H x 3.5' W gate opening is located on the downstream face of the principal spillway near the northeast abutment. The opening invert is 752.2' MSL. The gate has been buried and is not now operational.

APPENDIX A

VISUAL INSPECTION CHECKLIST

VISUAL INSPECTION CHECKLIST
PARTY ORGANIZATION

PROJECT Sargent Lake Dam, NH DATE Sept. 7, 1979

TIME 10:00

WEATHER Sunny, warm

W.S. ELEV.	U.S.	DN.S.
	764.7	752.2

PARTY:

1. Stephen Gilman (ANCo)
2. Gus Sharry (ANCo)
3. Ken Stuart (ANCo)
4. Mehdi Miremadi (ANCo)
5. Ronald Hirschfeld (GEI)
6.
7.
8.
9.
10.

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	Hydrology/Hydraulics	M. Miremadi	
2.	Structural Stability	S. Gilman	
3.	Soils & Geology	R. Hirschfeld	
4.			
5.			
6.			
7.			
8.			
9.			
10.			

PERIODIC INSPECTION CHECKLIST

PROJECT Sargent Lake Dam, NH DATE Sept. 7, 1979

PROJECT FEATURE Dam Embankment NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
DAM EMBANKMENT	
Crest Elevation	
Current Pool Elevation	
Maximum Impoundment to Date	
Surface Cracks	None observed
Pavement Condition	Not paved
Movement or Settlement of Crest	None observed
Lateral Movement	None observed
Vertical Alignment	Good
Horizontal Alignment	Good
Condition at Abutment and at Concrete Structures	Good
Indications of Movement of Structural Items on Slopes	None observed
Trespassing on Slopes	Trespassing and bare soil on downstream slope next to southwest abutment of spillway section
Sloughing or Erosion of Slopes or Abutments	See "Trespassing on Slopes"
Rock Slope Protection - Riprap Failures	None observed - riprap on upstream face between masonry section and northeast abutment
Unusual Movement or Cracking at or Near Toe	None observed
Unusual Embankment or Downstream Seepage	Wet area downstream of embankment section near northeast abutment. May be groundwater discharge
Piping or Boils	None observed
Foundation Drainage Features	None observed
Toe Drains	None observed
Instrumentation System	None observed
Vegetation	Heavy growth of trees and brush on upstream and downstream slopes

PERIODIC INSPECTION CHECKLIST

PROJECT Sargent Lake Dam, NH DATE Sept. 7, 1979

PROJECT FEATURE Intake Channel & Structure NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	
a. Approach Channel	
Slope Conditions	Good
Bottom Conditions	Not visible beneath lake surface
Rock Slides or Falls	None
Log Boom	None
Debris	None observed
Condition of Concrete Lining	Not visible
Drains or Weep Holes	None
b. Intake Structure	STOPLOG OPENING
Condition of Concrete	Surface very rough - loss of surface laitance
Stop Logs and Slots	1.9' wide - treated wood embeded in concrete
	1½" thick treated wood stoplogs. Condition - no visible underflow
Slots	Steel angles are surface corroded

PERIODIC INSPECTION CHECKLIST

PROJECT Sargent Lake Dam, NH DATE Sept. 7, 1979

PROJECT FEATURE _____ NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	PRINCIPAL SPILLWAY
a. Approach Channel	
General Condition	Good
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	None
Floor of Approach Channel	Not visible beneath lake surface
b. Weir and Training Walls	Weir - concrete capped stone masonry
General Condition of Concrete	Fair - surface of concrete is very rough with surface erosion to expose coarse aggregate
Rust or Staining	Only at steel embedded items
Spalling	Some chipping of concrete weir crest
Any Visible Reinforcing	None
Any Seepage or Efflorescence	Major seepage with some sand-discharge deposits at toe of masonry section (5-20 gpm est.)
Drain Holes	None
c. Discharge Channel	
General Condition	Good
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	Some trees overhanging channel
Floor of Channel	Boulders and soil
Other Obstructions	Some cut brush adjacent to channel Note: There is an embedded steel beam at the d/s lip of the spillway that is badly corroded.

PROJECT Sargent Lake Dam, NH

DATE Sept. 7, 1979

PROJECT FEATURE Reservoir

NAME M. Miremadi

AREA EVALUATED	REMARKS
Stability of Shoreline	Good
Sedimentation	None observed
Changes in Watershed Runoff Potential	None
Upstream Hazards	None
Downstream Hazards	4 road crossings, numerous homes around State Route 106, Hurricane Road and State Route 140
Alert Facilities	None posted
Hydrometeorological Gages	None
Operational & Maintenance Regulations	None posted

APPENDIX B

ENGINEERING DATA

State of New Hampshire
WATER RESOURCES BOARD
37 Pleasant Street
Concord, N.H. 03301
TELEPHONE 271-3406

May 25, 1978

Sargent Lake Association
Belmont,
New Hampshire 03220

Dear Sir:

Under the provisions of RSA Chapter 482, Sections 8 through 15, copy enclosed, on May 24, 1978, an engineer of the Water Resources Board inspected your dam in Belmont. This Dam, No. 21.03, is classified in the files of this Office as a menace structure and as such must be maintained in a manner not to endanger public safety nor become a dam in disrepair.

As a result of this inspection it was noted that an item of maintenance was in need of attention:

1- Some of the trees on the right abutment should be cut now before they grow into large trees.
2- Left embankment consists of loose rocks and earth: The facing is not done properly. During high water this could wash out.

Because this dam is classified as a menace structure, we require that you send us a proposed schedule of repairs. The actual work does not have to begin until the weather is better, but we need this schedule within thirty (30) days.

If you have any questions, please contact us at your convenience.

Sincerely,

George McGee Sr.

George M. McGee, Sr.,
Chairman

GMM:paf
Enc.

NEW HAMPSHIRE WATER RESOURCES BOARD

INSPECTION REPORT

Town: Belmont Dam Number: 21.03

Name of Dam, Stream and/or Water Body: Sargent Lake dam

Owner: Sargent Lake Association Telephone Number:

Mailing Address: Belmont NH.

Max. Height of Dam: 14 ft Pond Area: 36 acres Length of Dam: ~~125~~ 230'-6"

FOUNDATION: Earth & Rock

OUTLET WORKS: Spillway section 46
Stop log section 2.5 wide 1.75 deep

ABUTMENTS: Rt abutment concrete
Lt abutment stone masonry with loose rock placed

EMBANKMENT: Earth. Right abutment has core cove wall
Left loose rock and earth

Note: Give Sizing, Condition and detailed description for each item, if applicable.

SPILLWAY: Length: 49'6" Freeboard: 3' & 5'

SEEPAGE: Location, estimated quantity, etc.

None

Changes Since Construction or Last Inspection:

1st Inspection after Reconstruction

Tail Water Conditions:

36" ϕ pipe under gravel road

Free flow

Overall Condition of Dam: Fair

Contact With Owner: NO

Date of Inspection: 5/24/78 Suggested Reinspection Date 1980

Class of Dam: Menace

Signature Keith D Larson

Date 5/24/78

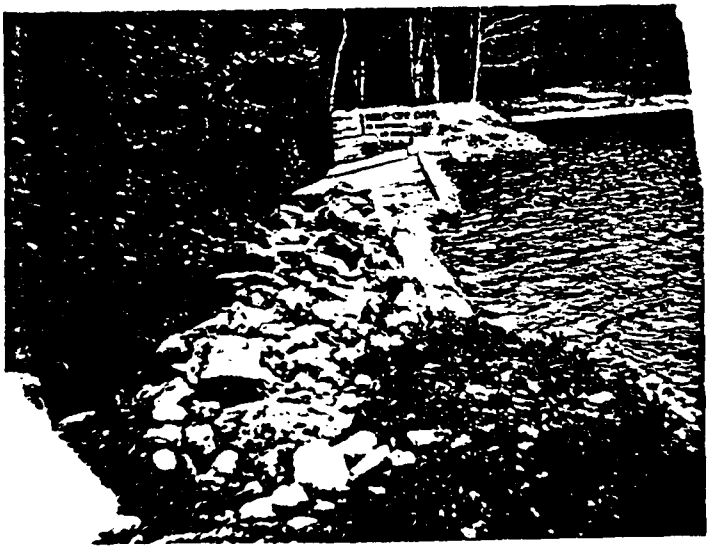
Note: Give Sizing, Condition and detailed description for each item, if applicable.

COMMENTS:

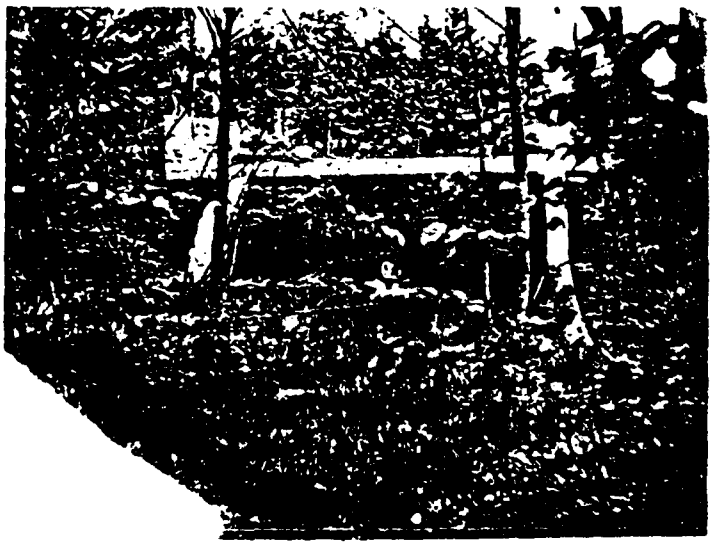
Some of the [illegible] on the abutment should be cut back before they fall into the [illegible]

Left embankment consists of loose rocks and earth. The fencing is not stone property. During high water this could wash out

Iowa Stone Left Bank 5/24/78

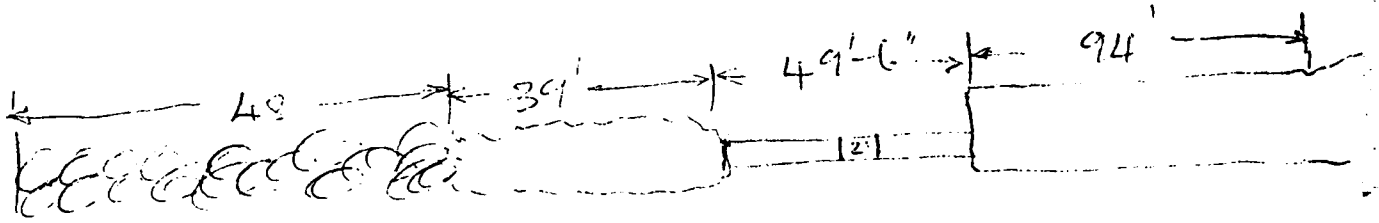


Iowa Downstream



Dam No. _____

SKETCH OF DAM (Show Plan, Elevation & Cross Sections)



48
31
49-6'
94
230'6"

U

N. H. WATER RESOURCES BOARD
Concord, N. H. 03301

DAM SAFETY INSPECTION REPORT FORM

Town: Sanbornton Dam Number: 21.03

Inspected by: SCB Date: 30 Oct 19 74

Local name of dam or water body: _____

Owner: _____ Address: _____

Owner was/was not interviewed during inspection.

Drainage Area: _____ sq. mi. Stream: _____

Pond Area: _____ Acre, Storage _____ Ac-Ft. Max. Head _____ Ft.

Foundation: Type _____, Seepage present at toe - Yes/No, _____

Spillway: Type _____, Freeboard over perm. crest: _____,

Width _____, Flashboard height _____,

Max. Capacity _____ c.f.s.

Embankment: Type _____, Cover _____ Width _____,

Upstream slope _____ to 1; Downstream slope _____ to 1

Abutments: Type _____, Condition: Good, Fair, Poor

Gates or Pond Drain: Size _____ Capacity _____ Type _____

Lifting apparatus _____ Operational condition _____

Changes since construction or last inspection: _____

_____

_____

Downstream development: _____

This dam would/would not be a menace if it failed.

Suggested reinspection date: _____

Remarks: Under Repair

_____

_____

_____

State of New Hampshire

WATER RESOURCES BOARD

File

37 Pleasant St.
CONCORD 03301

August 8, 1974

Mr. Robert J. Artick, President
Sargent Lake Association
R.F.D. #2 Box 116B
Laconia, NH 03246

Gentlemen:

Enclosed are permits to make the necessary repairs to the dam at the outlet of Sargent Lake in Belmont.

It is our understanding that the necessary repairs will consist of a reinforced concrete upstream facing and a reinforced concrete replacement spillway with no increase in the height of the spillway. The Board must be informed of any departure from the above mentioned items.

Very truly yours,

George M. McGee, Sr.
Chairman

gmmg/dmr:js
enclosures

MANCHESTER UNION
February 1, 1938

21.02

Cold Wave Nips Belmont Danger As Dike Breaks

Tioga River Overflows Highway, Recedes as Mercury Drops

Belmont and neighboring communities along the Tioga river were recovering today from a flood scare which arose early yesterday when an earthwork dike at the end of Sargent dam gave way above the town. A large volume of muddy, ice-laden water was released into the Badger dam reservoir a mile below, where the basin was inadequate and the stream, temporarily a torrent, overflowed its banks.

The accident was attributed to the sudden and freakish thaw which had set in Sunday and which ended just as abruptly today, when the mercury plummeted 20 degrees or more in the space of four hours. The drop in temperature was accompanied by a light snow and sleet storm of short duration while accumulated water and slush froze over roads, resulting in a few accidents.

Fair Weather Ahead.

Improvement in conditions was forecast for today and tomorrow, however, as the temperature dropped more gradually and meteorologists promised fair weather for both days, with colder temperatures today.

At Manchester, where the mercury had held in the upper 40's and lower 50's since noon Sunday, the Union-Leader telemeter-thermometer showed a drop from 52 to 32 degrees between 11 a. m. and 3 p. m. yesterday. At midnight, last night, the reading was just under 18 degrees.

State highway 106 was inundated to a depth of two feet where it runs along the Tioga river near Badger dam, just above Belmont, when the dike at Sargent dam gave way. Water rose nearly to the porch of the Charles Willey house on Depot street in that town, and was well up on the foundation walls of the Leon Heath place.

The bank of the river in a bend just below the spot where the dike gave way was washed out for some distance, and the shoulder of the state road was eroded, but the macadam surface of the highway was not damaged and traffic was not interrupted.

Nearly Back to Normal

The water began to recede with the drop in temperature about noon and was back nearly to its normal level late last night. The thermometer reading had fallen from 42 to 23 degrees. The dike, a built-up portion of the stream's bank, apparently was weakened by the alternate spells of warm and cold weather which have occurred through January. It fell about dawn yesterday, with a roar which awakened many Belmont residents. The dam itself, a concrete structure, apparently was undamaged. It is one of the oldest in the section, but considerable repair work has been done on it in the past few years.

The Badger and Garmond dams below it, and which belong to the Belmont Hosiery company as does the Sargent dam, withstood the assault of the huge wave of water and ice without damage. Removal of the flashboards at the first sign of danger helped to avert a greater flood and to control the run-off. An indication of the menace which confronted the town is seen, however, in the fact that the road which was under two feet of water yesterday was barely awash at the high-water mark in the greatest freshet experienced there several years ago.

MEMORANDUM

Case No. C46-C
Dam 31.03

TO; Water Control Commission

RE: Sargent Reservoir in Belmont

This dam has been completed and final inspection made by Mr. Colman.

The section was considerably increased as we requested and I recommend that final approval be given.

Richard S. Holmgren
Chief Engineer

1/11/39

NEW HAMPSHIRE WATER CONTROL COMMISSION
DATA ON RESERVOIRS & PONDS IN NEW HAMPSHIRE

ATION AT DAM NO. 21.93

vn Belmont : County Belknap

eam Badger Brook

ain—Primary Merrimack R. : Secondary Winnepesaukee R. (Winnipesaukee R)

cal Name Sargent Reservoir

INAGE AREA

ntrolled 2.73 Sq. Mi.: Uncontrolled 1.46 Sq. Mi.: Net Total 1.23 Sq. Mi.

VATION vs. WATER SURFACE AREA vs. VOLUME

	Point	Head Feet	Surface Area Acres	Volume Acre Ft.
(1)	Max. Flood Height	765.70	36.0	
(2)	Top of Flashboards	765.70	36.0	
(3)	Permanent Crest	766.70	42.68	
(4)	Normal Drawdown		36.0	
(5)	Max. Drawdown			13,900,000 cu.ft.
(6)	Original Pond	765.70	36.0	318acre ft.

Base Used U.S.G.S. Coef. to change to U.S.G.S. Base

ERVOIR CAPACITY

	Total Volume	Useable Volume
Drawdown	ft.	ft.
Volume	318 318 ac. ft.	318 ac. ft.
Acre ft. per sq. mi. (1.23)		
Inches per sq. mi.		

OF WATER Belmont Hosiery Co. Storage

ER Belmont Hosiery Co.

ARKS West section of dam carried out in flood of 1936
Re-built in Spring-summer 1938 Menace

39

C.D.C.

NEW HAMPSHIRE WATER CONTROL COMMISSION
DATA ON DAMS IN NEW HAMPSHIRE

LOCATION STATE NO. 21.03

Town Belmont : County Belknap

Stream Badger Brook

Basin-Primary Merrimack R. : Secondary Winnepesaukee R.

Local Name Sargent Reservoir

Coordinates—Lat. 43° 25' +12500 FT ✓ : Long. 71° 30' +5800 FT. ✓ 3.53 Total

GENERAL DATA

Drainage area: Controlled 2.73 Sq. Mi.: Uncontrolled 1.46 Sq. Mi.: Net Total 3.83 Sq. Mi.

Overall length of dam 125 ft.: Date of Construction Re. Const. 8/6/38

Height: Stream bed to highest elev. 20' ft.: Max. Structure 16' ft.

Cost—Dam : Reservoir

DESCRIPTION

Waste Gates

Type

Number 1 : Size 3' ft. high x 2' ft. wide

Elevation Invert 16' : Total Area 6 sq. ft.

Hoist Gear Shaft & Rack

Waste Gates Conduit

Number : Materials

Size ft.: Length ft.: Area sq. ft.

Embankment

Type Earth

Height—Max. 10' ft.: Min. 0 ft.

Top—Width 6' : Elev. ft.

Slopes—Upstream 2 on 1 : Downstream 1½ on 1

Length—Right of Spillway 48' : Left of Spillway 30'

Spillway

Materials of Construction wood

Length—Total 45 ft.: Net 44 ft.

Height of permanent section—Max. 20' ft.: Min. 15' ft.

Flashboards—Type stop logs in slots : Height 4' ft.

Elevation—Permanent Crest 761.70 : Top of Flashboard 765.70

Flood Capacity 850 880 cfs.: 310 229.6 cfs/sq. mi.

C= 2.5, 4' capacity 44' length

Abutments

Materials: earth-clay core-Driven Plank

Freeboard: Max. 4' ft.: Min. 33 3.3 ft.

Headworks to Power Devel.—(See "Data on Power Development")

OWNER Belmont Hosiery Co.,

REMARKS Flood carried away west section in 1936, Reconstructed Spring & Summer 1938

PUBLIC SERVICE COMMISSION OF NEW HAMPSHIRE—DAM RECORD

1-3948

TOWN: BELMONT	TOWN NO.: 3	STATE NO.:
RIVER / STREAM: SARGENT RESERVOIR		
DRAINAGE AREA: 2.50 Sq. Mi.	POND AREA:	
DAM TYPE: GRAVITY	FOUNDATION NATURE OF: Earth	
MATERIALS OF CONSTRUCTION: BOULDERS, TIMBER, CONCRETE		
PURPOSE OF DAM: POWER—CONSERVATION—DOMESTIC—RECREATION—TRANSPORTATION—PUBLIC UTILITY		
HEIGHTS, TOP OF DAM TO BED OF STREAM: 17'	TOP OF DAM TO SPILLWAY CRESTS: 29"	
SPILLWAYS, LENGTHS DEPTHS BELOW TOP OF DAM: 48.7' 10 days Av. 4.14"		LENGTH OF DAM: 290'
FLASHBOARDS TYPE, HEIGHT ABOVE CREST: Removable 21"		
OPERATING HEAD CREST TO N. T. W.	TOP OF FLASHBOARDS TO N. T. W.	
WHEELS, NUMBER KINDS & H. P.		
GENERATORS, NUMBER KINDS & K. W.		
H. P. 90 P. C. TIME 100 P. C. EFF.	H. P. 75 P. C. TIME 100 P. C. EFF.	
REFERENCES, CASES, PLANS, INSPECTIONS.		
REMARKS		

2151

B-17

21.03

June 13, 1951

Mr. George Wells, Superintendent
Belmont Hosiery Company
Belmont, New Hampshire

Dear Mr. Wells:

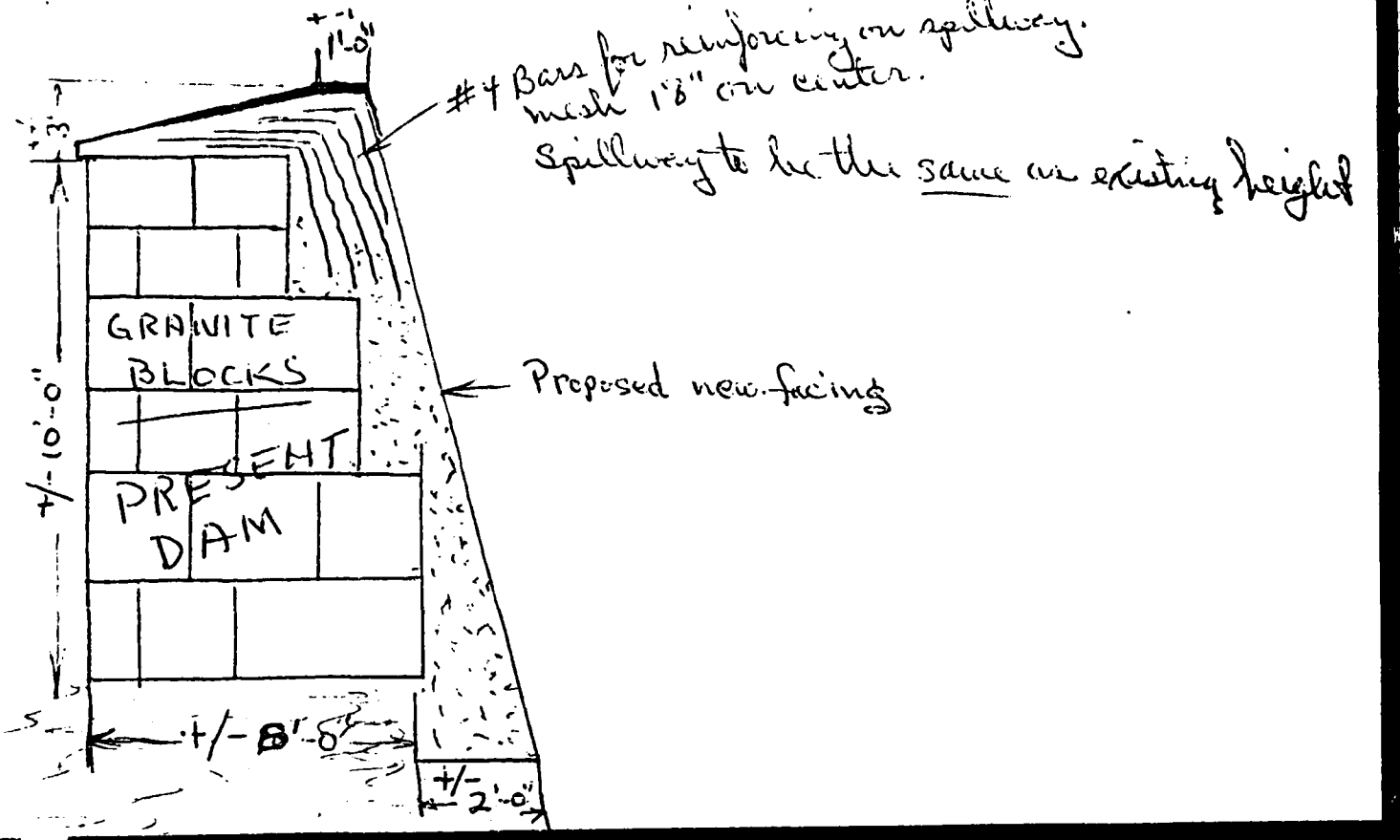
Confirming my conversation with you and Mr. Clarence Shaw, this Board recommends that you remove all flashboards from your spillways at Sargent Reservoir, Gorman Reservoir and Bean Reservoir, all in the town of Belmont, New Hampshire.

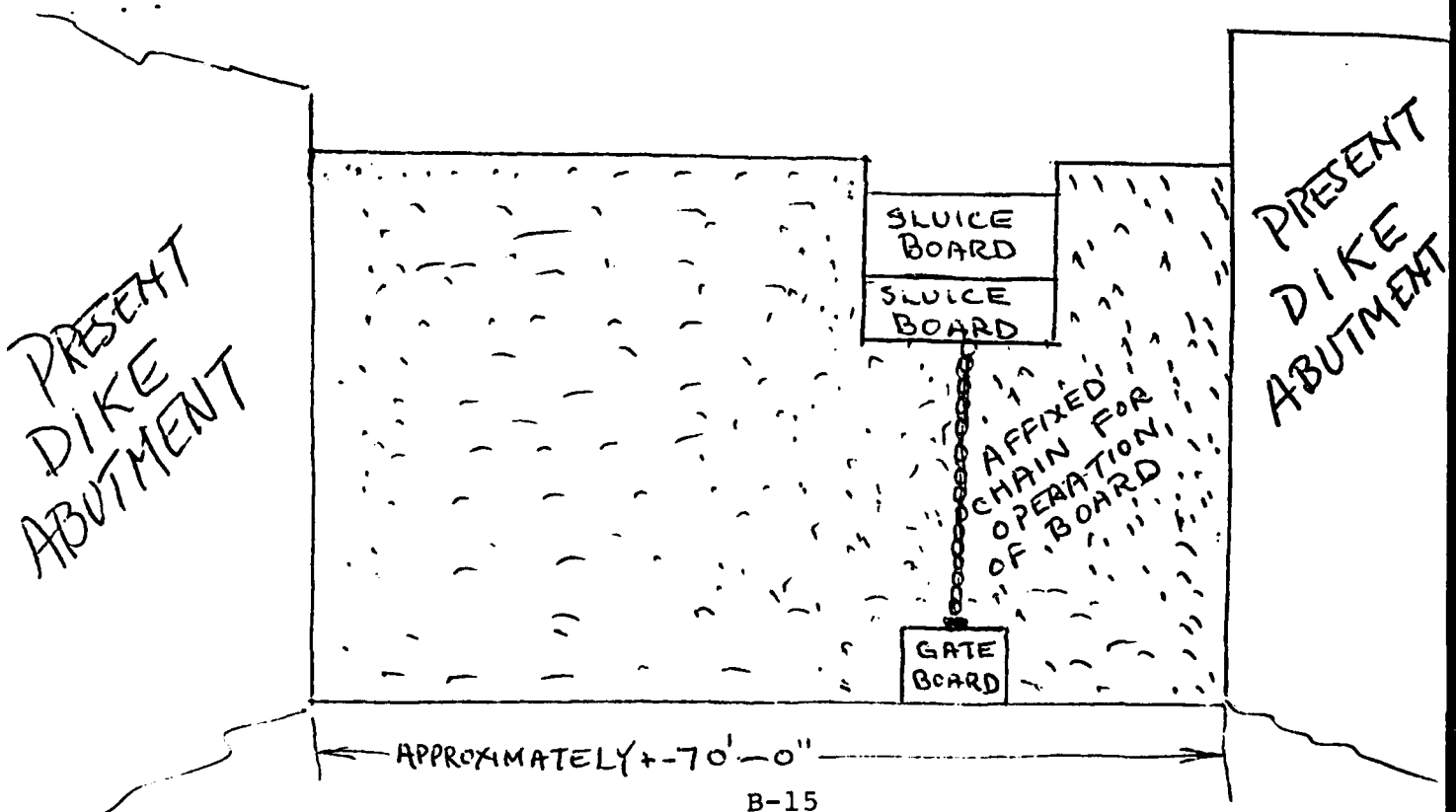
These flashboards should be removed as soon as practicable and certainly before the fall rains. These flashboards should be permanently removed as the stability of the timber crib, rock-filled dams doesn't warrant the use of flashboards until such time as the dams are sufficiently strengthened.

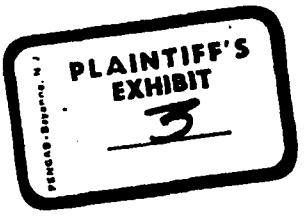
Very truly yours,

Francis C. Moore
Civil Engineer

fcm:c


+/- 1'-0"
#4 Bars for reinforcing on spillway. mesh 1'8" on center.
Spillway to be the same as existing height
GRANITE BLOCKS
PRESENT DAM
Proposed new facing
+/- 10'-0"
+/- 8'-8"
+/- 2'-0"


PRESENT DIKE ABUTMENT
SLUICE BOARD
SLUICE BOARD
AFFIXED CHAIN FOR OPERATION OF BOARD
GATE BOARD
PRESENT DIKE ABUTMENT
APPROXIMATELY +-70'-0"



DATE: October 21, 1971

FROM: Donald M. Rapoza
Water Resources Engineer

SUBJECT: Dam inspection at outlet of
Sargent Lake in Belmont - #21.03

TO: Vernon A. Knowlton
Chief Water Resources Engineer

On September 28, 1971, I inspected the dam at the outlet of Sargent Lake in Belmont. The inspection was the result of two letters complaining about the condition of the dam.

The present owner of the dam is a Julia Flaherty, 27 State Street, Boston, Massachusetts.

The timbers in the existing spillway have rotted away with sections of the plank decking. The lake was approximately one foot below the spillway crest and all flowage downstream of the dam is attributable to leakage through the dam. There is an immediate danger of losing approximately two feet of spillway crest this spring with large runoffs and ice action. This would undoubtedly increase the leakage through the deteriorated upstream plank face and endanger the whole structure.

The shaft from the pond drain gate was poorly braced and supported. The timbered crib dike is in poor shape. Most of the timbers have rotted away and the stone fill material has been ineffective in its intended use. The top and downstream side of the section of earthen dike has a large growth of brush and trees.

Recommend the following:

All brush and trees be removed from the dike; the spillway be rebuilt, the gate stem mechanism be made operable and protected; repair or replace the upstream planking on the dam; and the timbered crib along the dike section be repaired or replaced.

Since this is a menace dam and becuase of its condition, this matter should be brought before the Board for action.

DMR/jb

measures you plan to undertake. Enclosed are the necessary forms to be completed and submitted to the Board before you proceed with any repairs or reconstruction.

Very truly yours,

Donald M. Rapoza
Water Resources Engineer

DMR/jb
Enc.

October 20, 1971

Miss Julia Flaherty
27 State Street
Boston, Massachusetts

Dear Miss Flaherty:

This letter concerns the present condition of the dam at the outlet of Sargent Lake in Belmont, New Hampshire.

On September 28, 1971, I made an inspection of the dam and found several serious deficiencies which need immediate attention.

Principal Spillway - Most of the main longitudinal timbers and wooden planking in the spillway section have rotted and unless repaired and, or replaced, the spillway section would probably be washed downstream with the spring runoff. This would definately endanger the safety of this dam.

At the time of the inspection the lake level was approximately one foot below the spillway crest and all downstream flow of the dam was passing thsough the structure. The upstream wooden plank decking has probably deteriorated and allows the water to pass through the structure. Unless the leakage is checked, the structure's stability and safety would be endangered.

Dike - The wooden crib members on the dike next to the dam have rotted, and the fill material is ineffective in its intended use as a filler material in stabilizing the dike. The crib should be replaced with a similar type crib or a substantial earthen embankment. All trees and brush should be removed from the top and slopes of the dike as the can cause a piping action.

Pond Drain - The stem from the pond drain gate was poorly supported and inoperable. The stem and lifting mechanism should be protected from the effects of large flows and be made operable.

Since this is a menace dam and in my opinion, a dam in disrepair, I suggest that you take immediate corrective steps to assure the safety of the dam and dike. Failure to make the necessary repairs could result in the Water Resources Board order under Chapter 482:9 which essentially states that the Board shall, after notice and public hearing, order the owner of the dam to make repairs or reconstruct within a fimed period of time.

In 1938 the dike at Sargent Lake was breached and inundated State Highway 106 with two feet of water along the Tioga River. Fortunately, no lives were lost, and with the deteriorated condition as it exists today, the chances of another failure have increased appreciably.

We request that you inform this office as soon as possible on what corrective

NEW HAMPSHIRE WATER CONTROL COMMISSION

REPORT ON DAM INSPECTION

TOWN Belmont DAM NO. 2103 STREAM Badger Brook

OWNER Belmont Hosiery Co. ADDRESS Belmont N.H.

In accordance with Section 20 of Chapter 133, Laws of 1937, the above dam was inspected by me on 6/12/57 accompanied by [illegible]

NOTES ON PHYSICAL CONDITION

Abutments Good- earth; poor in timber crib [illegible]

[illegible] a sizable foundation leak probably thru porous ledge rock.

Spillway Good

Gates operable

Other

CHANGES SINCE LAST INSPECTION

FUTURE INSPECTIONS

This dam (is) ~~(is not)~~ a menace because of head & pondage

REMARKS [illegible]

Copy to Owner	Date

[illegible]
INSPECTOR

B-11

(Additional Notes Over)

'46-C

MEMORANDUM

TO: Richard S. Holmgren, Chief Engineer

RE: Sargent Dam, Belmont.

Inspected the Sargent dam Wednesday, August 10. The dam has been completed and the additional crib work to the front of the right section looking up stream added as you required. There is a small amount of leakage under this section. Mr. Duffy has been dumping in fill to block up the leak. He has also dumped a quantity of stone at the point where the new section and old section abut. The top cross members on the top layer facing down stream were not tied in with a heading timber across the whole front face. However, I doubt if this would have any effect on the dam unless it was topped, and as the new section is approximately one and one-half feet higher than the abutment on the east side, if the water got to this elevation the east abutment would go out.

From the new section on the west end going southwest, the mill has put in a quantity of fill taken from a bank on the east side and faced the up stream slope with riprap. The top width of this fill averages five and one-half feet. I could not tell from inspection whether there is sheathing driven in for a cut-off for this section or not and I did not have or could not find Bryant's plan of the dam. When I came back from the dam I could not locate anyone to ask.

I do not believe this section would cause any damage unless it was topped by water and if the filled section meets your approval, I would recommend that the dam be given approval and the file closed.

Respectfully submitted

Charles D. Coleman

Charles D. Coleman
Assistant Engineer

Edward S. Laskowski
15 Sharon Road
Trumbull, Conn. 06611

Water Resources Board
State of New Hampshire
South Spring Street
Concord, New Hampshire

Re: Sargent Lake
Belmont, N. H.

Gentlemen:

As President of the Sargent Lake Association I have been authorized by the membership to bring to your attention the matter of the Dam at Sargent Lake, Brown Hill Road, Belmont, New Hampshire.

The Dam is presently listed in the ownership of Julia Flaherty, Suffolk County, Boston, Massachusetts (Business Address: 27 State St., Boston, Massachusetts).

Arnold S. Dane, attorney at law, 27 State Street, Boston, Massachusetts, 02109, principal owner and developer of Sargent Lake deeded the dam to the above-named (Julia Flaherty) who is a secretary with his law firm. Mr. Dane has apparently done this to avoid legal liability on his part.

This background information leads to the problem of the Dam. The dam is presently 100 years old and leaking rather badly. The cap of the dam is in imminent danger of collapse. It is a hazard for children and fisherman and there are no signs posted to this effect.

Upon reading the Manual "State of New Hampshire Water Resources Board" the following articles seem to be pertinent and violated.

Article 482:8
" 482:9
" 482:13
" 482:14
" 482:35 and most significantly Article 482:42

Further, the possible collapse of this dam may present a threat to other streams, land and property to say nothing of the approximate 40 home owners on Sargent Lake.

I hereby request immediate looking into of this emergency situation.

Sincerely,

Edward S. Laskowski, Pres.
Sargent Lake Association

This dam was conveyed to the grantor by deed of Paramount Realty, Inc. (Arnold Dane, Pres.) dated March 28, 1969, recorded with said Registry of Deeds, Book 515, Page 492.

Sargent Lake Association

Sargent Lake • Belmont, New Hampshire

July 16, 1974

RECEIVED
JUL
REC'D ENGINEERING
WATER RESOURCES BOARD

Mr. George M. McKee, Chairman
Water Resources Board
Concord, New Hampshire, 03301

Dear Mr. McKee,

In compliance with your instructions are the two (2) applications for a permit to be issued to the Sargent Lake Dam, Belmont, New Hampshire, requesting your permission to drain lake to allow contractor to make the necessary construction to repair the leaking dam.

A proposed plan of the new construction to the present dam is enclosed for your convenience and will comply with any suggestions or recommendations you may make. Also Mr. Donald M. Rapoza, a Water Resources Engineer from your office is quite familiar with the project and would suggest you inquire of him any pertinent information regarding this dam. He also has pictures in his files.

As President of the Sargent Lake Association and in their behalf I look forward for an affirmative reply from your board so that the necessary repairs may be made.

Sincerely,

Robert J. Artick, President
ROBERT J. ARTICK

RJA/ELA

Please reply to:
Robert J. Artick
R.F.D 2 Box 116B
Laconia, N.H. 03246

5 enclosures

NEW HAMPSHIRE WATER CONTROL COMMISSION
DATA ON DAMS IN NEW HAMPSHIRE

LOCATION STATE NO. 21-03

Town Belmont : County Belknap

Stream Lane River

Basin-Primary Merrimack River : Secondary

Local Name Sargent's Reservoir

Coordinates—Lat. 43° 25' + 12500' : Long. 71° 30' + 5800'

GENERAL DATA

Drainage area: Controlled Sq. Mi.: Uncontrolled Sq. Mi.: Total 3.83 Sq. Mi.

Overall length of dam 125' ft.: Date of Construction New Dam 1938

Height: Stream bed to highest elev. 16 ft.: Max. Structure 12'9 + 8'9 ft.

Cost—Dam : Reservoir

DESCRIPTION Gravity timber stop log dam

Waste Gates

Type

Number 1 : Size 3' ft. high x 2' ft. wide

Elevation Invert 16' : Total Area 6' sq. ft.

Hoist Gear Shaft & Racks

Waste Gates Conduit

Number : Materials

Size ft.: Length ft.: Area sq. ft.

Embankment

Type

Height—Max. ft.: Min. ft.

Top—Width : Elev. ft.

Slopes—Upstream on: Downstream on

Length—Right of Spillway : Left of Spillway

Spillway

Materials of Construction

Length—Total ft.: Net 44' ft.

Height of permanent section—Max. 12.9 ft.: Min. 8.9 ft.

Flashboards—Type : Height 4' ft.

Elevation—Permanent Crest : Top of Flashboard

Flood Capacity cfs.: cfs/sq. mi.

Abutments

Materials:

Freeboard: Max. 3'3 + 7'3 ft.: Min. ft.

Headworks to Power Devel.—(See "Data on Power Development")

OWNER Belmont Hosiery Co.

REMARKS General Condition Excellent

Tabulation By Date

B4BS1284

Assigned	File
Secty.	
Emily	
Barry	
Swain	
E	

No. (D-E 4642)
D-E 1734

Layout Rev

New Hampshire Public Service Commission

QUESTIONNAIRE - STATEMENT

Concerning Mills and their repairs, Dams and Flowage

Chapter 218, Public Laws of New Hampshire

RECEIVED
SEP 1 0 1935
N. H. Public Service Commission

LOCATION

1. In what town? Belmont, N. H.

2. On what stream? Badger Brook

3. Give location definite as possible by description and by indication on plan or map In section 25 North & South and 25 East & West on N.H.Gilmanton Topographical Map of 1919.

ERECTION:

4. Is it proposed to erect a new dam on a new location? No.

5. Is it proposed to erect a new dam on a location previously occupied? No.

REPAIRS:

6. Is it proposed to make minor repairs (repairs that can be made without lowering the pond level, diverting flow and interfering with operation)? Replaced planks which were worn out.

RECONSTRUCTION:

7. Is it proposed to make major repairs, (requiring a lowering of pond level, diverting flow and interfering with operation)? No.

8. Is it proposed to increase the height of the dam permanently? No.

9. Is it proposed to increase the height of the dam by flashboards? No.

10. Is it proposed to increase the height of the dam by increasing the height of the original flashboards?

No.

OWNERSHIP:

11. Who will or does own the dam and appurtenances?

Name Belmont Hosiery Company,

Address Belmont, N. H.

12. Who owns the premises upon which the dam is or will be built?

Name Belmont Hosiery Company,

Address Belmont, N. H.

13. Who owns the premises flowed by the dam or will be when built?

Name Belmont Hosiery Company,

Address Belmont, N. H.

14. Who will or does maintain the dam?

Name Belmont Hosiery Company,

Address Belmont, N. H.

15. Who will or does operate the dam?

Name Belmont Hosiery Company,

Address Belmont, N. H.

16. Has the consent of the owners of the land upon which the dam is to be built, been obtained?

17. Has the consent of the owners of the land that will be flowed by the dam been obtained?

PURPOSE:

(Check opposite the designation under which this dam is) (or will be classed.)

18. Conservation ( )

19. Domestic ( )

20. Power (X)

21. Recreation

(a) Private ( )

(b) Commercial ( )

22. Transportation ( )

DIMENSIONS:

23. What is or will be the area of the pond created by the dam? Same as formerly.

24. What is or will be the length of the pond from the dam upstream? Same as formerly.

25. What is or will be the length of the dam? Same as formerly

26. What is or will be the height of the dam above the bed of the stream? Same as formerly

27. What is or will be the length and depth of the spillway? Same as formerly

28. What is or will be the number and size of openings? Same as formerly

MATERIALS:

29. Of what materials is the dam constructed? Wood & Stone

30. Of what materials will the dam be constructed? Same

31. What is the nature of the foundation where or upon which the dam is or will be built? (Ledge - hardpan - sand gravel - clay - etc. and extent)? Ledge

TIME:

32. When will the job be begun? Fall 1934.

33. When will the job be completed? Fall 1934.

PLANS AND SPECIFICATIONS:

34. Submit plans (plan, elevations, cross sections) of dam, giving information as to foundations, showing dimensions, etc. None

PERSONNEL:

35. Who will be Engineer?

Name Arthur Preble.

Address Belmont, N. H.

36. Who will be contractor or constructor?

Name Arthur Prebel,

Address Belmont, N. H.

REMARKS:

Dated:

Sept. 18, 1935.

Signed:

W. F. Duffy Jr.

NEW HAMPSHIRE WATER RESOURCES BOARD

INVENTORY OF DAMS AND WATER POWER DEVELOPMENTS

DAM

BASIN _____ NO. _____

RIVER _____ MILES FROM MOUTH _____ D.A.SQ.MI _____

TOWN _____ OWNER _____

LOCAL NAME OF DAM _____

BUILT 1911 DESCRIPTION _____

POND AREA-ACRES _____ DRAWDOWN FT. _____ POND CAPACITY-ACRE FT. _____

HEIGHT-TOP TO BED OF STREAM-FT. _____ MAX. _____ MIN. _____

OVERALL LENGTH OF DAM-FT. _____ MAX.FLOOD HEIGHT ABOVE CREST-FT. _____

PERMANENT CREST ELEV.U.S.G.S. _____ LOCAL GAGE _____

TAILWATER ELEV.U.S.G.S. _____ LOCAL GAGE _____

SPILLWAY LENGTHS-FT. _____ FREEBOARD-FT. _____

FLASHBOARDS-TYPE,HEIGHT ABOVE CREST _____

WASTE GATES-NO. WIDTH MAX.OPENING DEPTH SILL BELOW CREST

REMARKS _____

POWER DEVELOPMENT

UNITS NO.	RATED HP	HEAD FEET	C.F.S. FULL GATE	KW	MAKE

USE _____

REMARKS _____

DATE _____

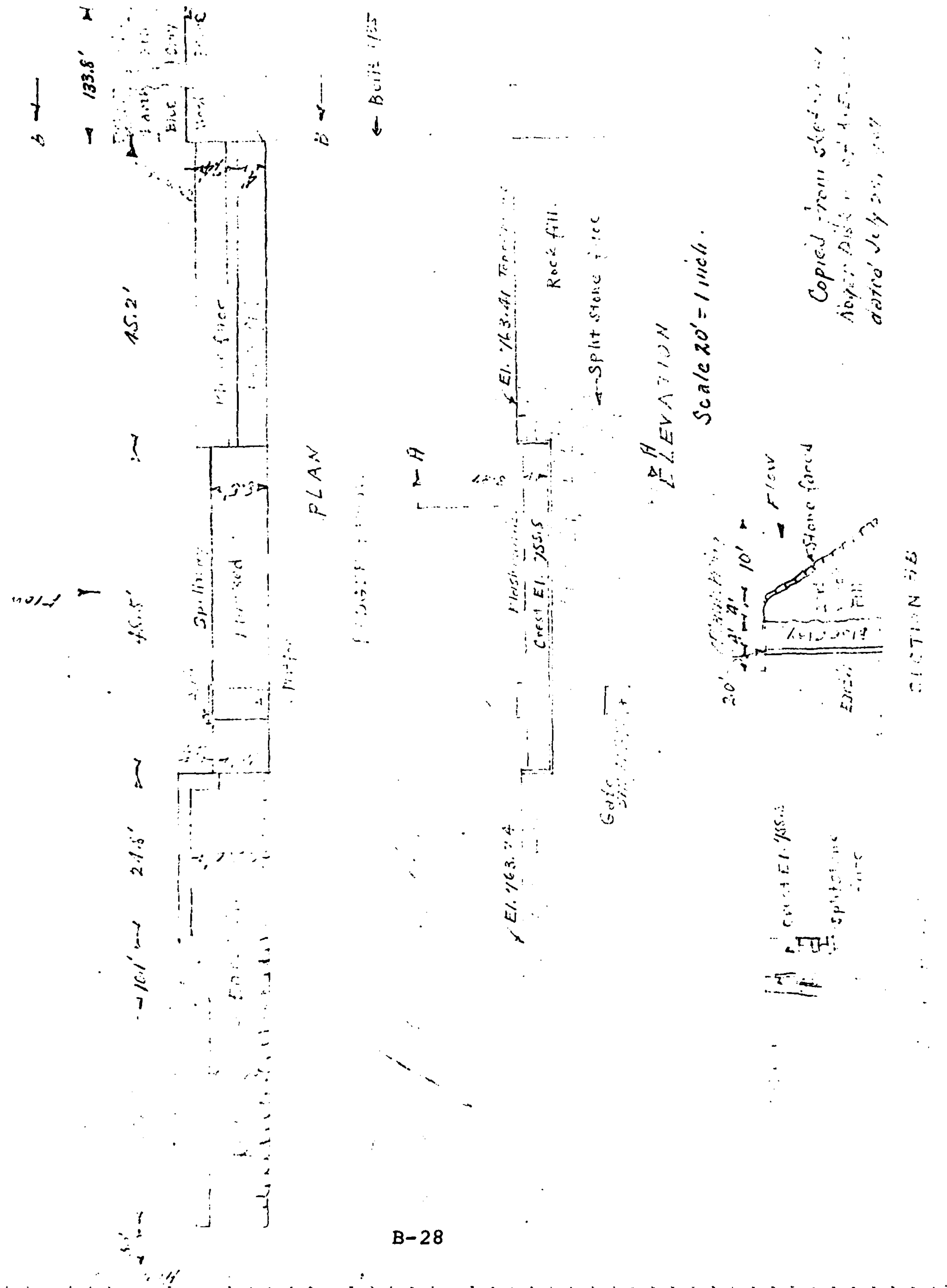
IW HAMPSHIRE
TER RESOURCES
BOARD
ONCORD, N. H.

PROJECT .... FILE ....

SUBJECT .... ACC. ....

Belmont

COMPUTER H.L. .... CHECKER .... CONT. FROM ACC. .... CONT. ON ACC. .... SUMMARY ON ACC. .... DATE ....



Town [illegible]: County [illegible]: Local Name [illegible]:

Function of Dam Storage Dam: Type Gravity - Timber Sheet Y core:

Primary Basin Merrimack Sec. Basin [illegible]: Local Stream [illegible]:

Drainage Area, Total 3.83 sq. mi.: Controlled ..... sq. mi.: Net Uncontrolled ..... sq. mi.:

Reservoir Area, Full Pond 36 acres: At Max. Drawdown ..... acres:

Reservoir Capacity 13.900 mcf.: 318 ac. ft.: ..... in. net D. A.: 1.55 in. Total D. A.:

Overall Length of Dam 125 ft.: Max. Depth Water at Dam 3.3 ft.:

Net Spillway Length 47 ft.: Minimum Freeboard 7.3 ft.:

OVER FLASHBOARD 660 CFS 172.3 CFS PER SQ MI.

Spillway Capacity 217.0 cfs.: 56.6 cfs. per sq. mi.:

GATE " 160 " 41.7 " " " " MAX.

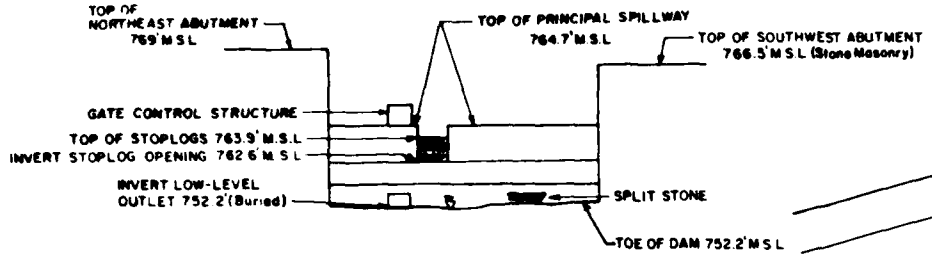
Highest Flood Flow of Record ..... cfs.: ..... cfs. per sq. mi.: Date .....

Estimated Maximum Probable Flood ..... cfs.:

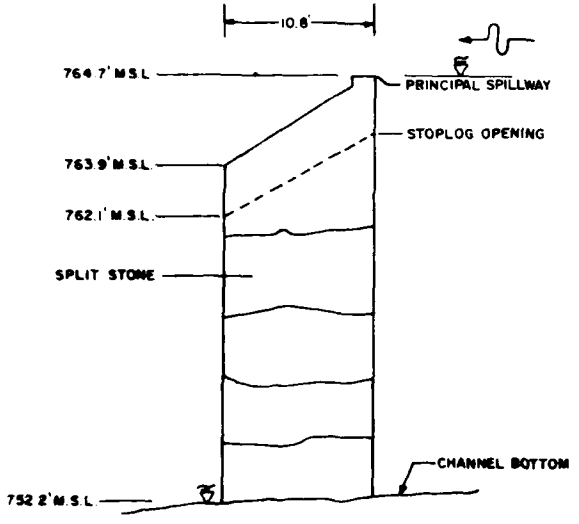
B-29

REMARKS: New dam 1938

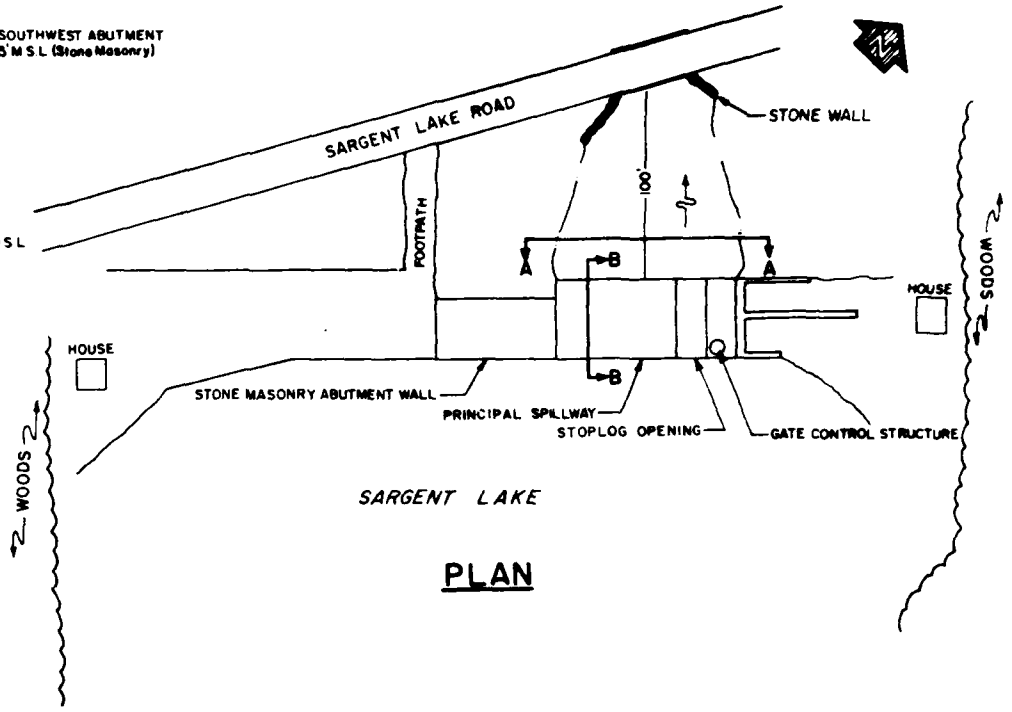
Card Prepared by CFO: Checked by .....: Approved for File .....: Date 9-13-



ELEVATION A-A



SECTION B-B



PLAN

NOTE: ALL ELEVATIONS ARE BASED ON ASSUMED NORTHEAST ABUTMENT ELEVATION OF 769' M.S.L. DATUM (N.G.V.D.).

Anderson-Nichols & Co., Inc. CONCORD NEW HAMPSHIRE	U.S. ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MA

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

SARGENT LAKE DAM

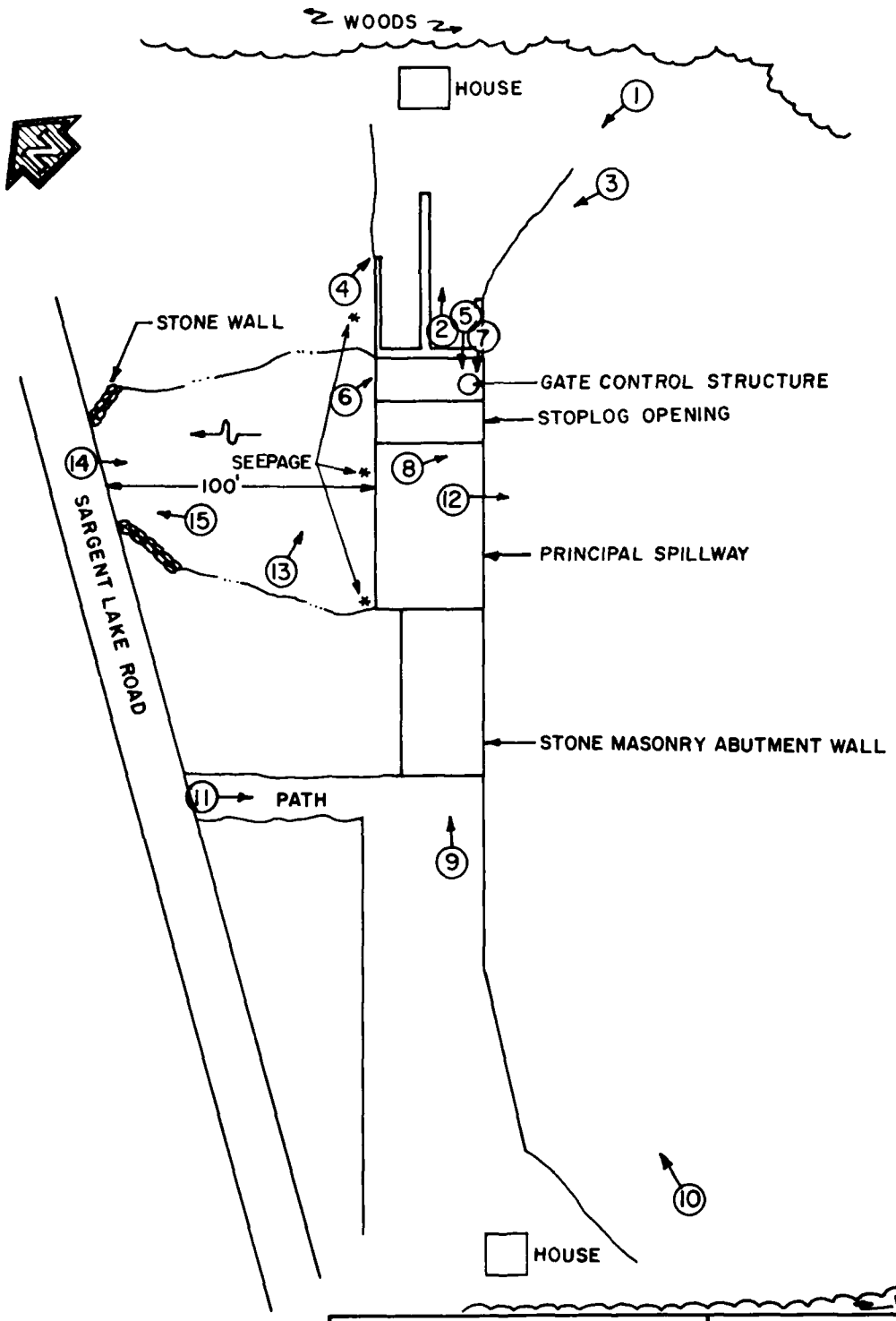
BADGER BROOK NEW HAMPSHIRE

SCALE NOT TO SCALE

DATE NOVEMBER 1979

APPENDIX C

PHOTOGRAPHS



Anderson-Nichols & Co., Inc. CONCORD NEW HAMPSHIRE	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MA.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

PHOTO INDEX

BADGER BROOK NEW HAMPSHIRE

			SCALE: NOT TO SCALE
			DATE: NOVEMBER 1979

September 7, 1979

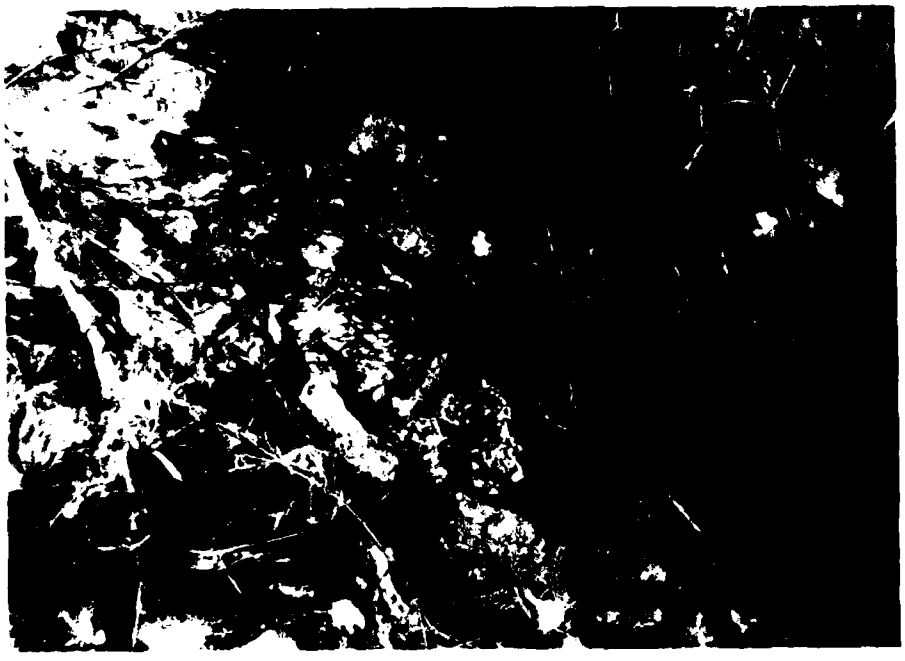
Figure 2 - Crest of embankment section from southwest end of masonry section looking toward northeast abutment.

September 7, 1979

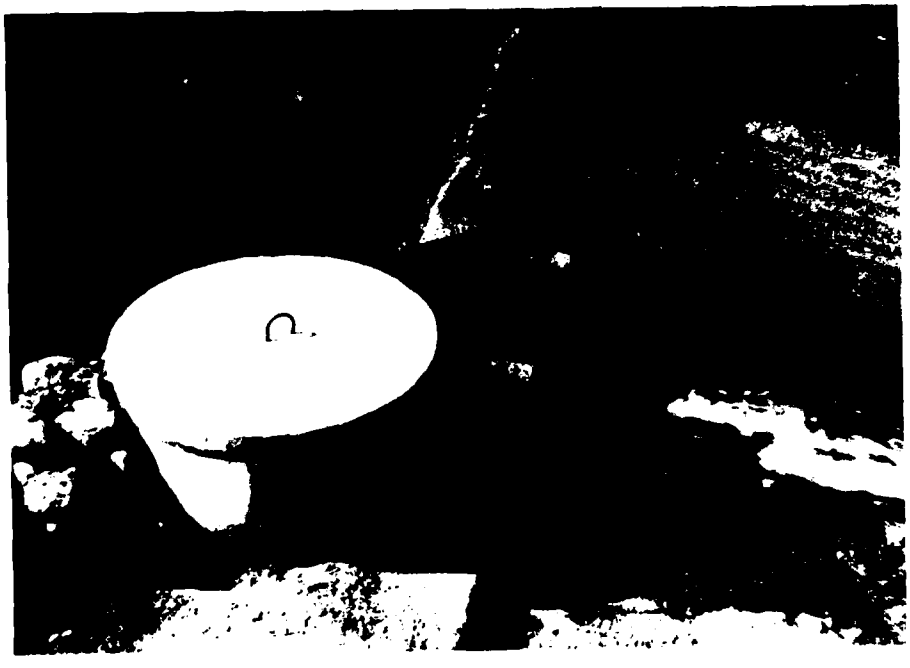
Figure 3 - Riprap on upstream slope of northeast embankment.

September 7, 1979
Figure 4 - Downstream of the toe of the dam.

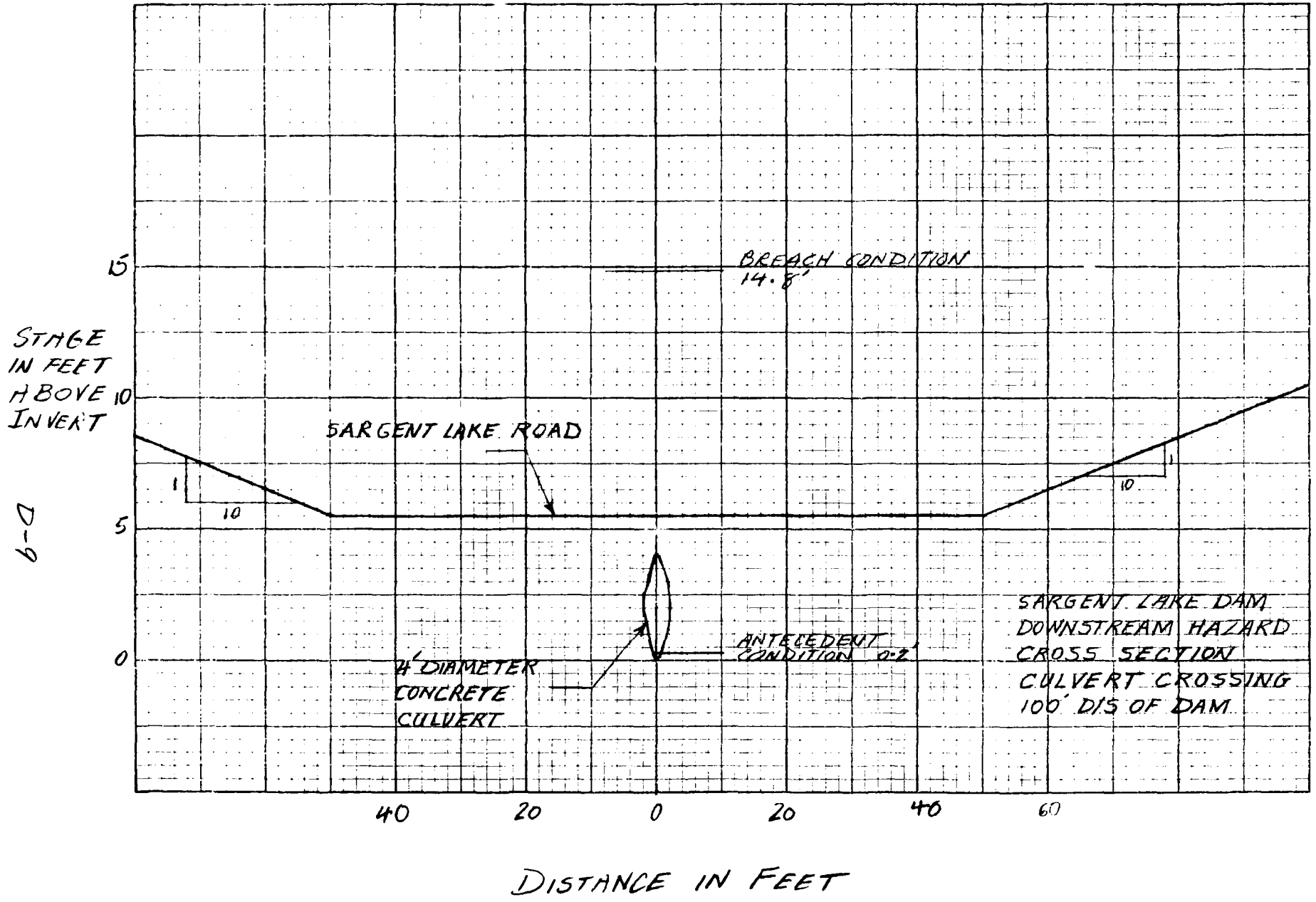
September 7, 1979
Figure 5 - View of principal spillway crest from top of northeast abutment.



September 7, 1979
Figure 6 - Leakage around low-level outlet.



September 7, 1979
Figure 7 - Stoplog opening from top of northeast abutment.


BREACH CONDITION
14.8'
SARGENT LAKE ROAD
ANTECEDENT
CONDITION 0.2'
4' DIAMETER
CONCRETE
CULVERT
SARGENT LAKE DAM
DOWNSTREAM HAZARD
CROSS SECTION
CULVERT CROSSING
100' DIS OF DAM
STAGE
IN FEET
ABOVE
INVERT
15
10
5
0
1
10
1
10
40
20
0
20
40
60
DISTANCE IN FEET

6-0

Nichols & Company, Inc. Subject BREACH ANALYSIS

Sheet No. _____ of _____
Date _____
Computed AMM
Checked _____

NO.

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28

THE FIRST CULVERT IS LOCATED ABOUT 100 FT. D/S OF THE DAM (WITH CROSS SECTIONAL AREA OF 12.6 FT^2. ORIFICE FLOW THROUGH THE CULVERT AND WEIR FLOW OVER THE ROAD WOULD OCCUR.

TRIAL NO.	STAGE (FT)	DISCHARGE (CFS)
1	5.5	$Q = Ca\sqrt{2gh}$ $C = 0.09$ $Q = (0.09)(12.6)\sqrt{(32.2)(2)(3.5)} = 170$
2	8	$Q = Ca\sqrt{2gh} + C_1 L H^{3/2}$ $\triangledown C_1 = 2.6$ $Q = (0.9)(12.6)\sqrt{2(32.2)(6)} + 2.6(100)(2.5)^{3/2}$ $Q = 1251$
3	10	$Q = (.9)(12.6)\sqrt{2(32.2)(8)} + 2.6(100)(4.5)^{3/2}$ $Q = 2139$
4	12	$Q = (.9)(12.6)\sqrt{2(32.2)(10)} + 2.6(100)(6.5)^{3/2}$ $Q = 4596$
5	15	$Q = .9(12.6)\sqrt{2(32.2)(13)} + 2.6(100)(9.5)^{3/2}$ $Q = 7941$
6	20	$Q = .9(12.6)\sqrt{2(32.2)(18)} + 2.6(100)(14.5)^{3/2}$ $Q = 14742$

USE ABOVE DATA TO DEVELOP A DISCHARGE RATING CURVE.

$\triangledown$ ESTIMATED FROM BRATER & KING HANDBOOK OF HYDRAULICS TABLE 4-11, P. 4-36

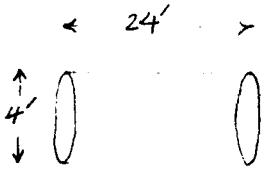
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28

REFERING TO THE RATING CURVE ON PAGE D-6

AT Q = 5 CFS (ANTECEDENT DISCHARGE) STAGE = 0.1'
AT Q = 7680 CFS (TOTAL FAILURE) STAGE = 9.9'

∴ AN INCREASE IN STAGE DUE TO BREACH OF 9.9 − 0.1 = 9.8 FT. WOULD RESULT. ALONG THE REACH FROM DAM TO STRUCTURE 100' D/S. NO INHABITED STRUCTURES EXIST IN THIS REACH.

ANALYSIS OF THE CULVERT 100' DOWNSTREAM OF DAM



USE ORIFICE EQUATION TO DETERMINE THE CAPACITY OF OPENING FLOWING FULL WITH WATER SURFACE ELEVATION AT TOP OF ROAD:

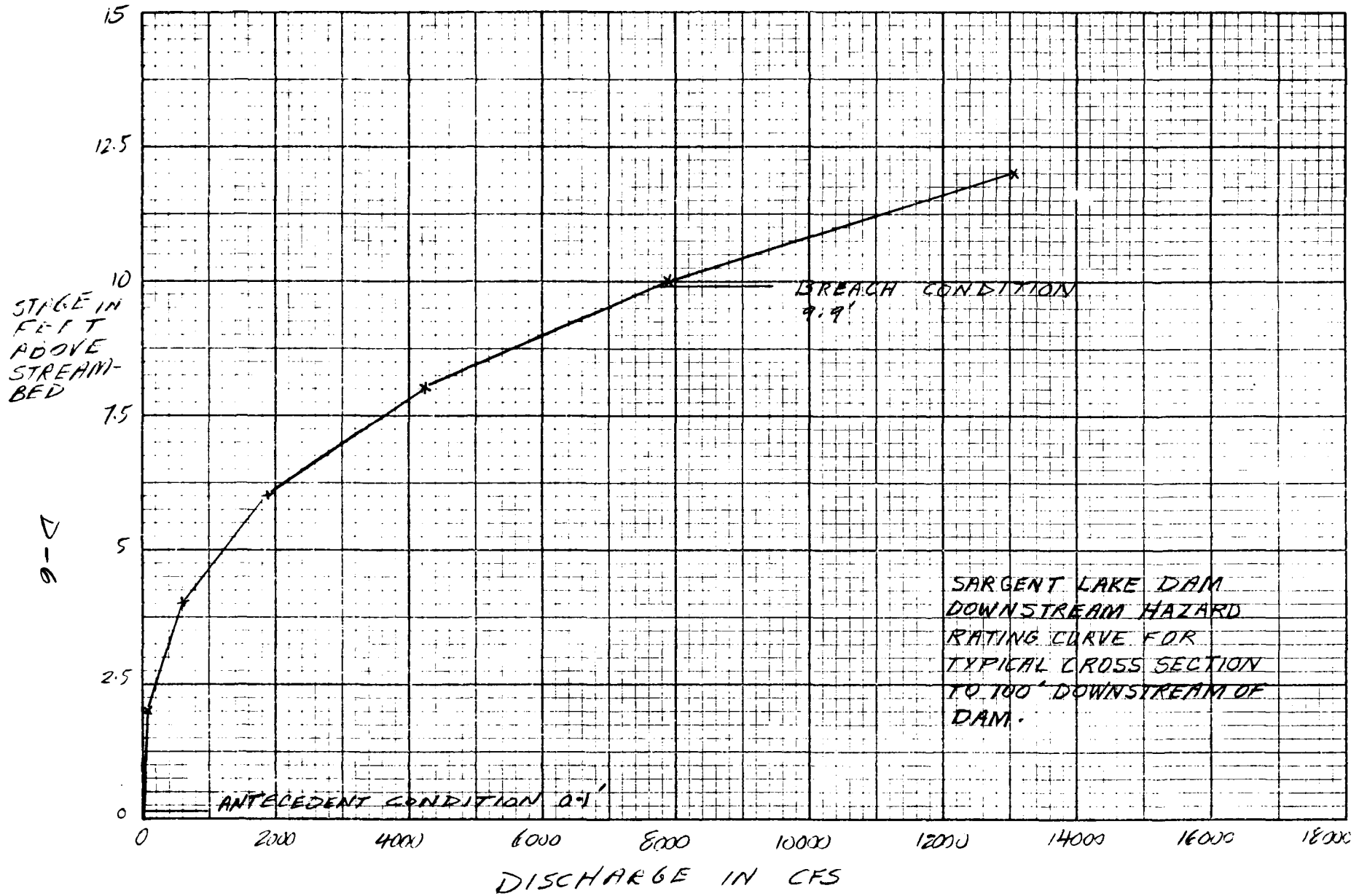
$$Q = C\,a\sqrt{2gh}$$

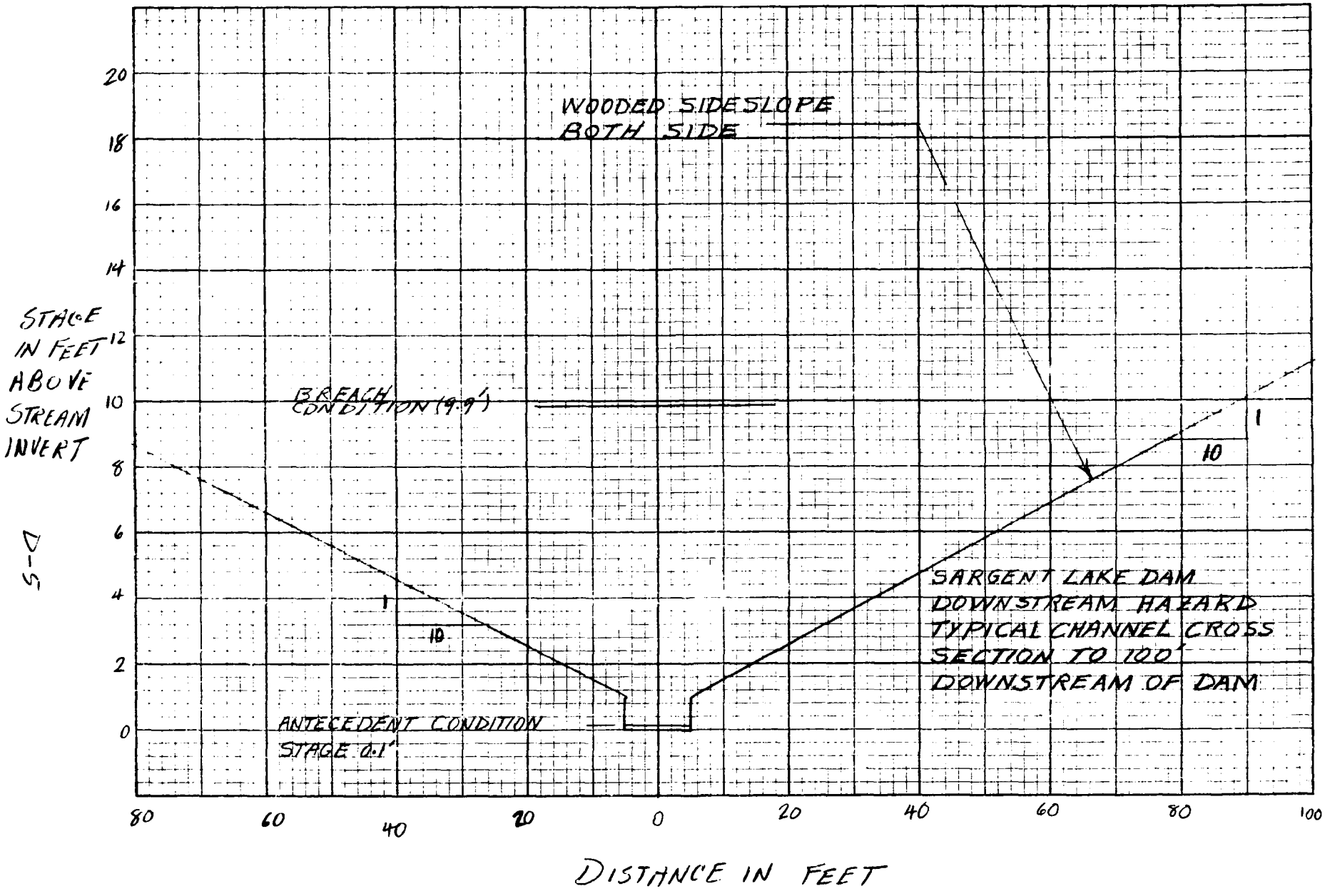
UPSTREAM STAGE = 5.5'
*C = 0.9

$$Q = (0.9)(12.6)\sqrt{2(32.2)(3.5)} = 169 \text{ CFS} \ll 7680$$

CULVERT WILL NOT CARRY TOTAL BREACH Q. USE THE MANNING EQUATION TO RATE FLOW THROUGH THE CULVERT UP TO A STAGE OF 5.5 FEET. A HIGHER STAGE WILL RESULT IN WEIR FLOW OVER SARGENT LAKE Rd., AND ORIFICE FLOW THROUGH THE CULVERT.

*ESTIMATED FROM BRATER & KING, HANDBOOK OF HYDRAULICS TABLE 4-11, PAGE 4-36


15
12.5
10
7.5
5
2.5
0
STAGE IN FEET ABOVE STREAM-BED
BREACH CONDITION 9.9'
ANTECEDENT CONDITION 0.1'
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
DISCHARGE IN CFS
SARGENT LAKE DAM
DOWNSTREAM HAZARD
RATING CURVE FOR
TYPICAL CROSS SECTION
TO 100' DOWNSTREAM OF
DAM.


WOODED SIDESLOPE
BOTH SIDE
BREACH CONDITION (9.9')
ANTECEDENT CONDITION
STAGE 0.1'
1
10
1
10
SARGENT LAKE DAM
DOWNSTREAM HAZARD
TYPICAL CHANNEL CROSS
SECTION TO 100'
DOWNSTREAM OF DAM
STAGE IN FEET ABOVE STREAM INVERT
DISTANCE IN FEET
20
18
16
14
12
10
8
6
4
2
0
80
60
40
20
0
20
40
60
80
100

S-1

on-Nichols & Company, Inc.

Subject BREACH ANALYSIS
SARGENT LAKE

Sheet No. _____ of _____
Date _____
Computed AA NAA
Checked _____

JOB NO.

MANNING'S EQUATION:

$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

WHERE n = COMPOSITE CHANNEL ROUGHNESS
A = AREA OF SECTION (FT^2)
R = HYDRAULIC RADIUS (FT)
S = SLOPE OF THE REACH

SLOPE OF THE REACH IS CALCULATED FROM THE U.S.G.S. QUAD SHEET AS FOLLOWS:

SARGENT LAKE ELEV. = 764.7' MSL
BADGER POND ELEV. = 575' MSL
DISTANCE BETWEEN = 1.7 miles = 8986'

$$S = \frac{189'}{8986'} = 0.021$$

ROUGHNESS COEFFICIENT USED:

$n = 0.08$ FOR WOODED EMBANKMENT
$n = 0.06$ FOR ROCKY STREAM

THE FOLLOWING TABLE WAS GENERATED USING A COMMODORE PET 2001 DESK COMPUTER. MANNING'S EQUATION FOR OPEN CHANNEL FLOW WAS PROGRAMMED INTO THE COMPUTER USING THE DATA ON PAGE

STAGE IN FT ABOVE STREAM BED	AREA (FT)	WPER (FT^2)	Q (CFS)
0	0	0	0
2	30	32.1	93
4	130	72.3	604
6	310	112.5	1895
8	570	152.7	4241
10	910	192.9	7884
12	1330	233.1	13044
14	1830	273.3	19926

USE ABOVE DATA TO DEVELOPE STAGE-DISCHARGE CURVE.

PRINCIPAL SPILLWAY AT STATION 300+02. THEREFORE

$W_b = 90'$

$y_o = 765.9 - 752.2 = 13.7'$

$Q_{P_1} = \left(\frac{8}{27}\right)(90)\left(\sqrt{32.2}\right)(13.7)^{3/2} = 7673$ CFS

ANTECEDENT DISCHARGE = 5 CFS
(SEE RATING CURVE - PAGE)

TOTAL BREACH Q = 7678 CFS

ASSUME Q = 7680 CFS
USE A TYPICAL CROSS SECTION OF THE REACH FROM THE TOE OF THE DAM TO THE FIRST CONCRETE PIPE CULVERT WHICH IS LOCATED ABOUT 100' D/S OF THE DAM. DEVELOP A DISCHARGE-RATING CURVE USING THE MANNING'S EQUATION.

→

PURPOSE: DETERMINE DEGREE OF DOWNSTREAM HAZARD

ASSUMPTIONS: 1- STOPLOGS IN PLACE
2- LOW-LEVEL OUTLET INVERT = 752.2' MSL
3- WATER SURFACE AT SPILLWAY CREST BEFORE BREACH OCCURS.

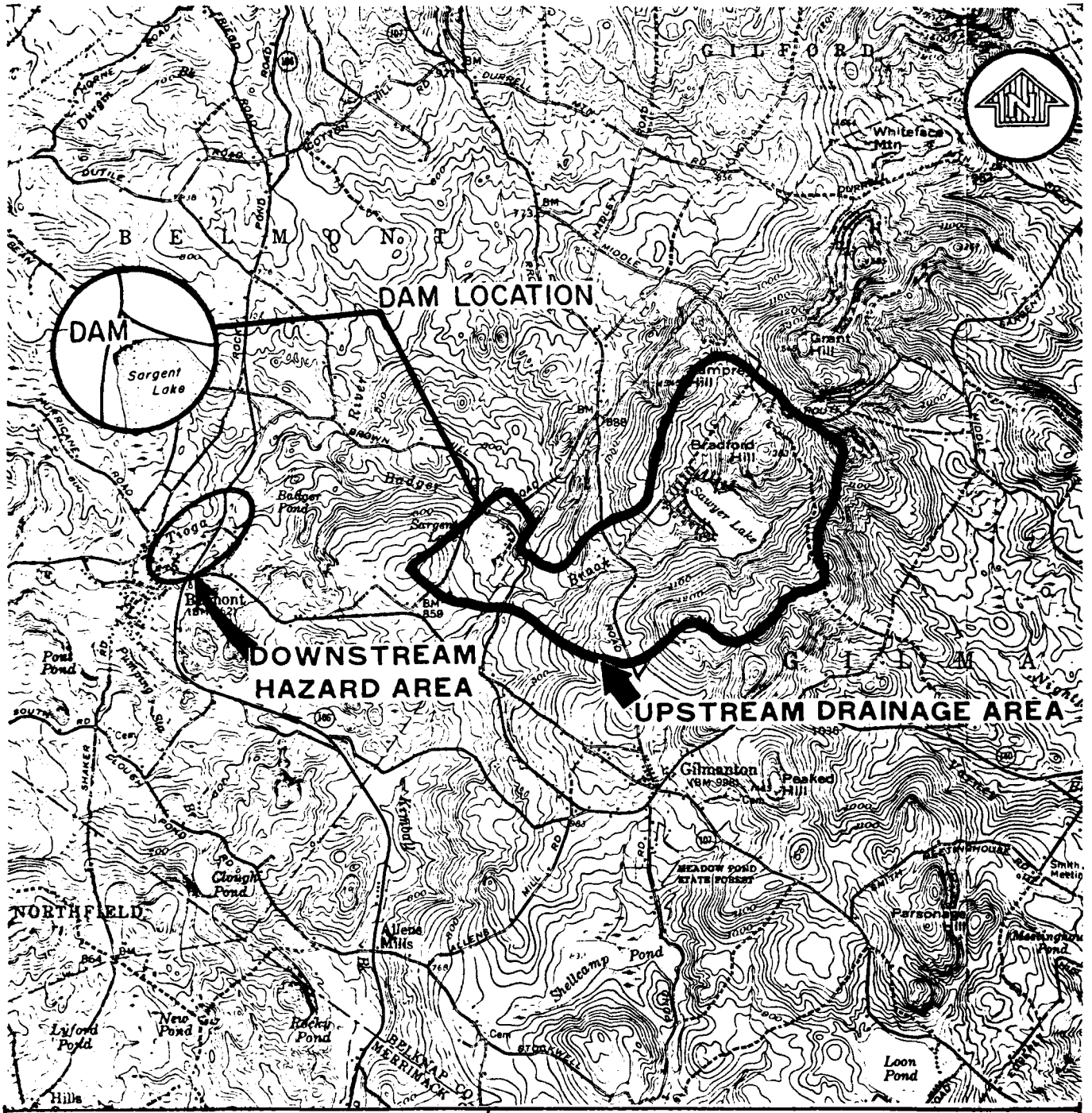
THE REASON FOR ASSUMING WATER SURFACE ELEVATION AT SPILLWAY CREST AT TIME OF BREACH IS BECAUSE IF WE ASSUME WATER ELEV. AT TOP OF DAM IN SARGENT WE MUST ALSO DETERMINE THE WATER SURFACE ELEV. RISE IN BADGER POND. TO DO THIS THE CSM VALUE FOR SARGENT LAKE DRAINAGE AREA WOULD BE SUPERIMPOSED TO BADGER POND DRAINAGE AREA TO OBTAIN THE DRAINAGE AREA INFLOW INTO BADGER POND BEFORE BREACH OF SARGENT LAKE. DUE TO THE DIFFERENCE IN SIZE, TIME OF CONCENTRATION, AND ANTECEDENT MOISTURE CONDITION IN THE DRAINAGE AREAS, SUCH CALCULATION WOULD BE TOO DETAILED FOR PHASE I DAM INSPECTION STUDY

Following equation is used for peak failure outflow "Q_{P_1}":

$$Q_{P_1} = \frac{8}{27} W_b \sqrt{g} \, y_o^{3/2}$$

where W_b = Breach width
y_o = Pool Elev. - U/S Riverbed Elev.

At Sargent Lake Dam it was determined that a breach would most probably occur from the beginning of the stone masonry at station 200+12 to end of



NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

SARGENT LAKE DAM
BELMONT, NEW HAMPSHIRE
REGIONAL VICINITY MAP
NOVEMBER 1979

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

ANDERSON-NICHOLS & CO., INC. CONCORD, NH

SCALE IN MILES

1 ½ 0 1 2

MAP BASED ON U.S.G.S. 15 MINUTE QUADRANGLE SHEET, GILMANTON, NEW HAMPSHIRE, 1957

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

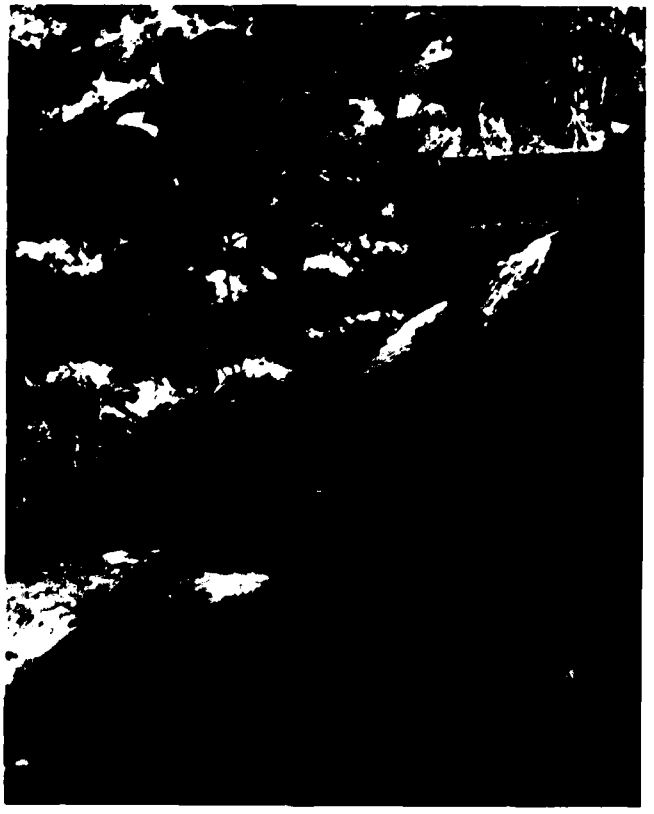
September 7, 1979

Figure 14 - View of the dam from Sargent Lake Road, 100 feet downstream of the dam.

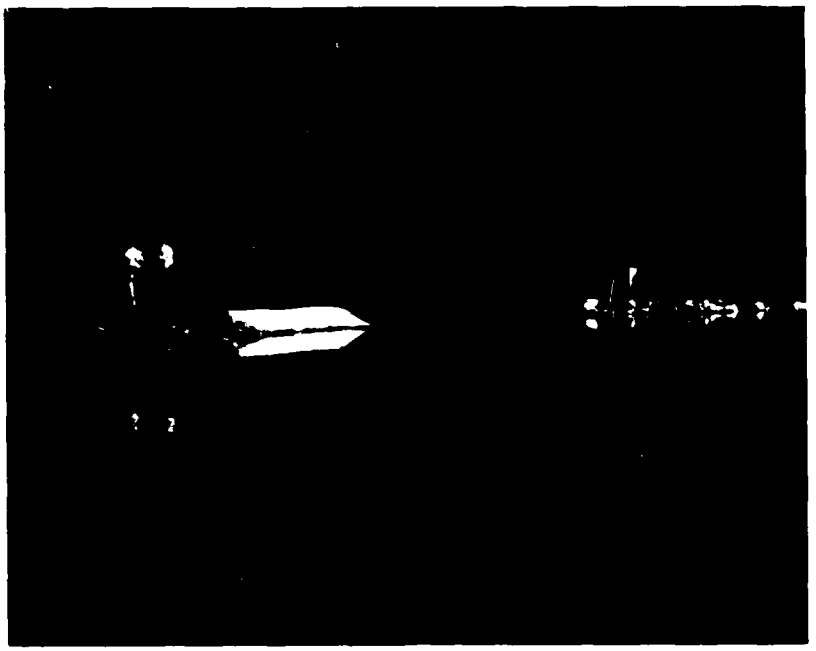
September 7, 1979

Figure 15 - Sargent Lake Road crossing the channel 100 feet downstream of the dam.

September 7, 1979
Figure 12 - View of the upstream reservoir.

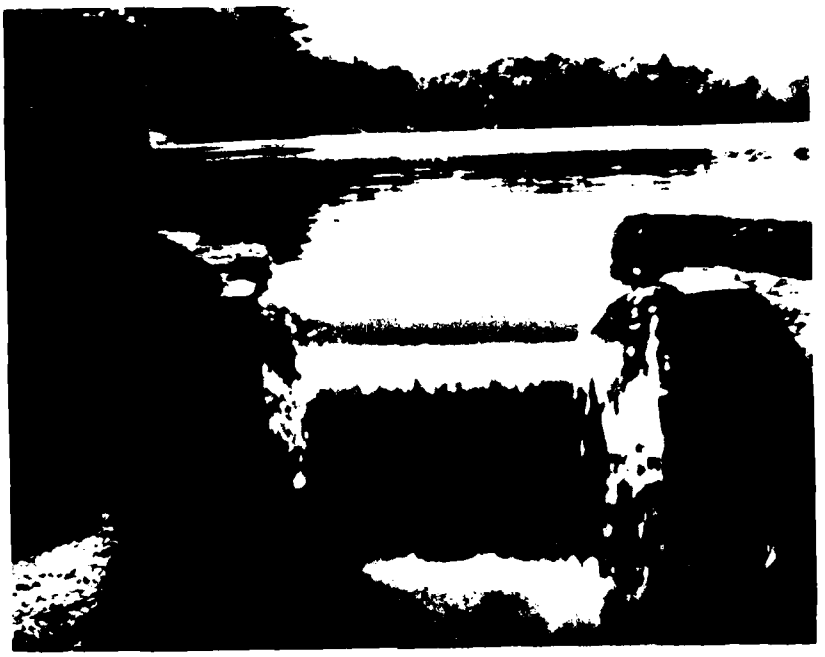


September 7, 1979
Figure 13 - View of downstream face of spillway.



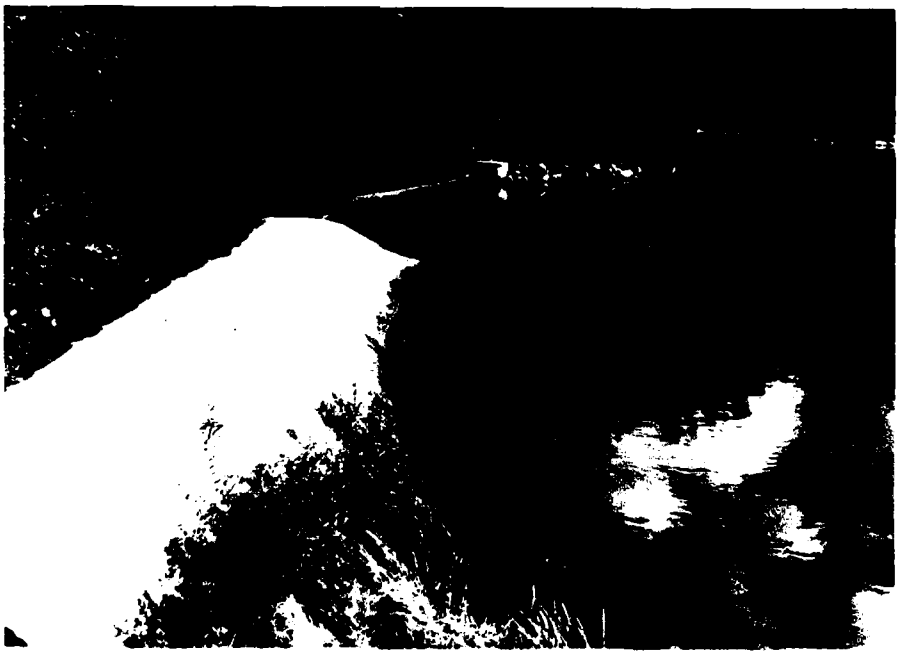
September 7, 1979
Figure 10 - View of upstream face of the dam.

September 7, 1979
Figure 11 - View of the path leading to the natural low point on top of the southwest embankment.



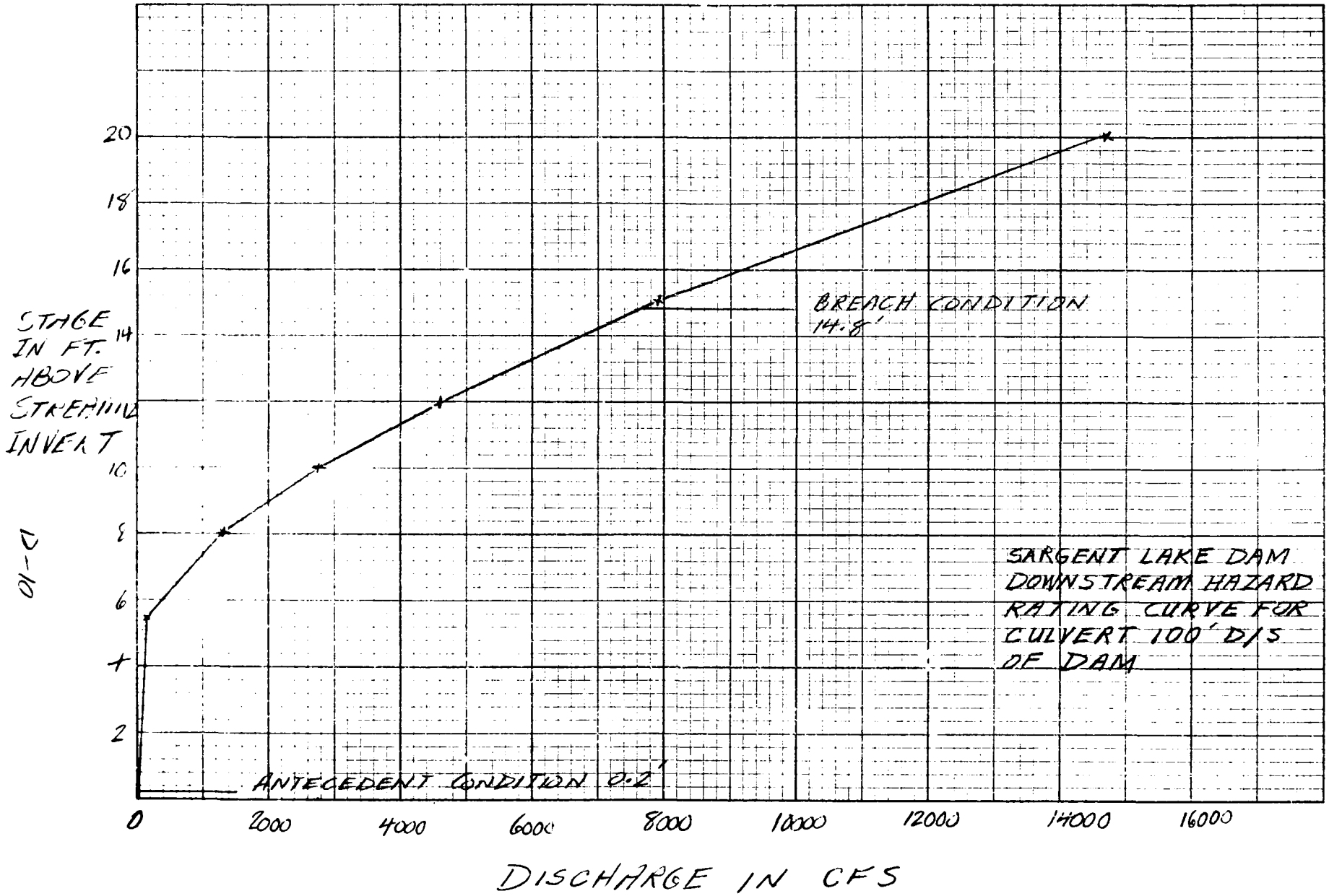
September 7, 1979

Figure 8 - Looking at stoplog opening from principal spillway crest.



September 7, 1979

Figure 9 - View of concrete capped stone masonry southwest abutment.


STAGE IN FT. ABOVE STREAM INVERT
20
18
16
14
12
10
8
6
4
2
0
2000
4000
6000
8000
10000
12000
14000
16000
BREACH CONDITION 14.8'
ANTECEDENT CONDITION 0.2'
SARGENT LAKE DAM
DOWNSTREAM HAZARD
RATING CURVE FOR
CULVERT 100' D/S
OF DAM
DISCHARGE IN CFS

01-01

Anderson-Nichols & Company, Inc.

Subject BREACH ANALYSIS

JOB NO.

Sheet No. _____ of _____
Date _____
Computed MNM
Checked _____

SQUARES 1/4 IN. SCALE 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28

REFERRING TO THE RATING CURVE ON PAGE D-10

AT Q = 5 CFS STAGE = 0.2'
AT Q = 7680 CFS STAGE = 14.8'

∴ AN INCREASE IN STAGE DUE TO BREACH OF 14.8' − 0.2' = 14.6' FT. WOULD RESULT. THIS WOULD RESULT IN SERGENT LAKE RD. BEING OVERTOPPED BY 8.5' FT. UNDER OVERTOPPING CONDITIONS OF THIS MAGNITUDE, THE SAND AND GRAVEL ROAD WOULD PROBABLY BE SEVERED.

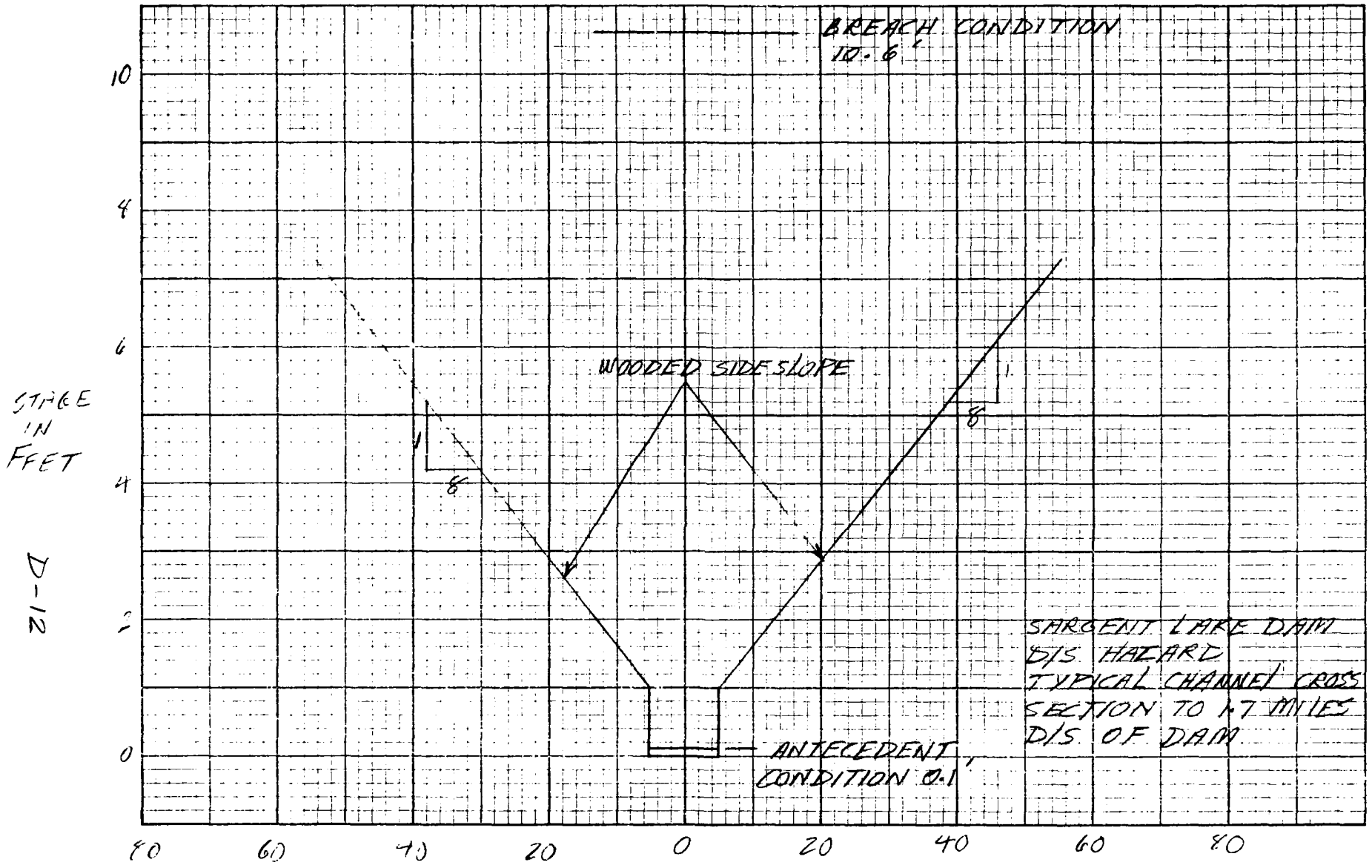
USE A TYPICAL CROSS SECTION OF THE REACH FROM SERGENT LAKE ROAD TO BADGER POND A DISTANCE OF 1.7 MILES.

DEVELOP A DISCHARGE RATING CURVE USING MANNING'S EQUATION.

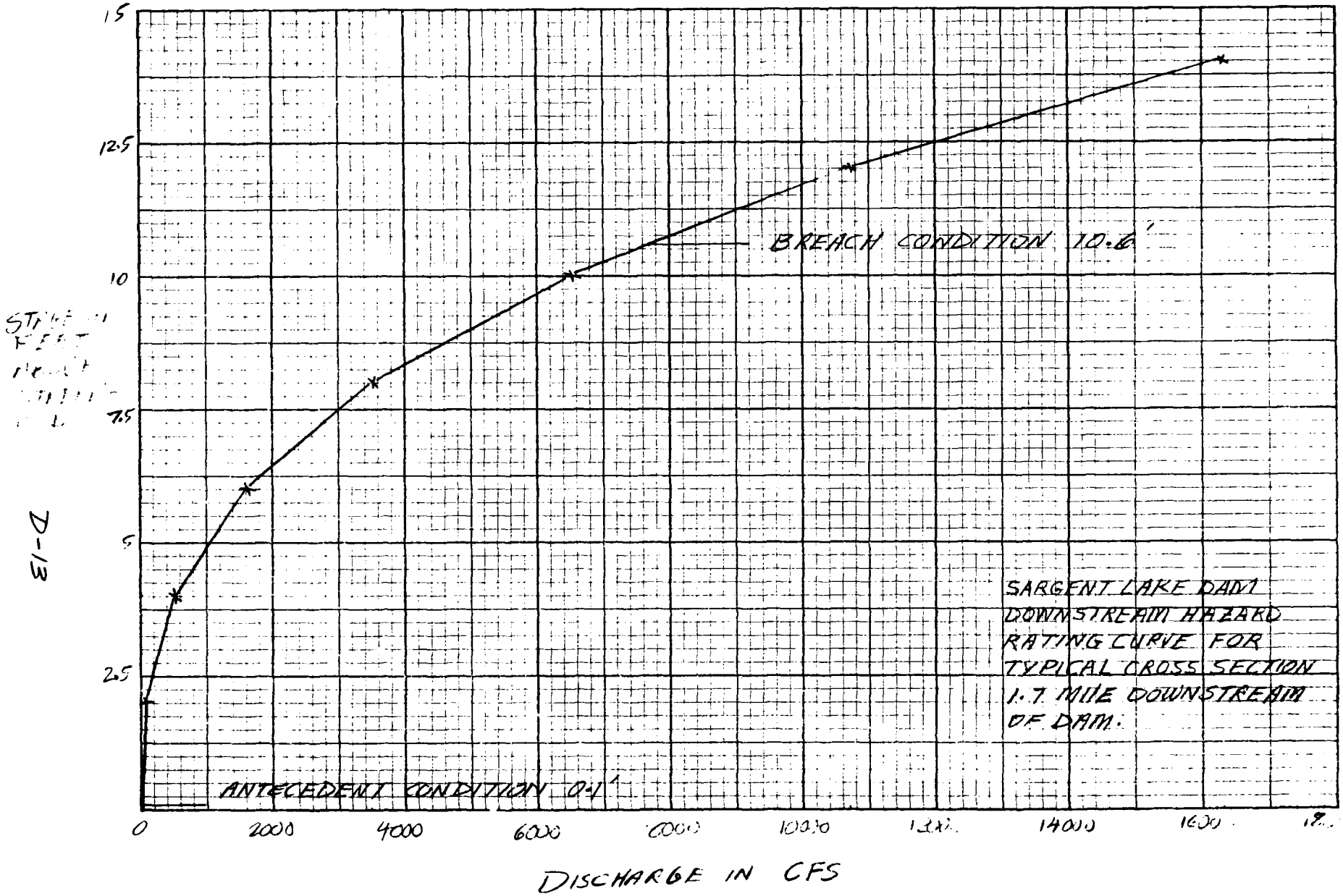
THE FOLLOWING TABLE WAS GENERATED USING A COMMODORE PET 2001 DESK COMPUTER. MANNING'S EQUATION FOR OPEN CHANNEL FLOW WAS PROGRAMMED INTO THE COMPUTER USING THE DATA ON PAGE

STAGE IN FT. ABOVE STREAMBED	AREA (FT²)	WIDTH (FT)	Q (CFS)
0	0	0	0
2	28	28.1	91
4	112	60.4	534
6	260	92.6	1614
8	472	124.4	3550
10	748	157.1	6533
12	1088	189.4	10738
14	1472	221.6	16327

USE ABOVE DATA TO DEVELOP A STAGE-DISCHARGE RATING CURVE.



D-12


15
12.5
10
7.5
5
2.5
0
2000
4000
6000
8000
10000
12000
14000
16000
BREACH CONDITION 10.6'
ANTECEDENT CONDITION 0.1'
SARGENT LAKE DAM
DOWNSTREAM HAZARD
RATING CURVE FOR
TYPICAL CROSS SECTION
1.7 MILE DOWNSTREAM
OF DAM.
DISCHARGE IN CFS

REFER TO THE RATING CURVE ON PAGE D-13

AT Q = 5 CFS STAGE = 0.1'
AT Q = 7660 CFS STAGE = 10.6'

∴ AN INCREASE IN STAGE OF 10.6 - 0.1 = 10.5' WOULD RESULT IN THE REACH FROM SARGENT LAKE ROAD TO BADGER POND. NO INHABITED STRUCTURES ARE LOCATED IN THIS REACH.

A BREACH OF SARGENT LAKE DAM WOULD PROVIDE AN ADDITIONAL INCREASE IN THE VOLUME OF WATER ENTERING BADGER POND.

DETERMINING MAXIMUM RISE IN BADGER LAKE LEVEL DUE TO BREACH OF SARGEN LAKE UPSTREAM:

FROM BADGER POND DAM RATING CURVE (SEE APPENDIX D - PAGE D-19) AT Q 7678 CFS (BREACH DISCHARGE) ELEV. = 584.7' MSL

THEREFORE BADGER POND WOULD BE OVERTOPPED BY

584.7' - 583 = 1.7'

IF SARGENT LAKE IS BREACHED.

IT WAS ASSUMED THAT BADGER POND WOULD NOT PROVIDE ANY STORAGE FOR SARGENT LAKE BREACH DISCHARGE DUE TO ITS SMALL SIZE AND ALSO TO DEFINE MAXIMUM POTENTIAL D/S HAZARD

REACH #1 : TYPICAL CROSS SECTION TO 600' D/S OF BADGER POND.

FROM RATING CURVE OF REACH #1 (SEE APPENDIX D - PAGE D-21) AT Q = 7678 CFS ⇒ ELEV. = 11'

ANTECEDENT DISCHARGE = 0.5'

RISE OF WATER ELEVATION DUE TO SARGENT LAKE DAM BREACH = 11 - 0.5 = 10.5'

THERE ARE NO INHABITED STRUCTURES IN THIS REACH.

ES 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
SCALE

STATE RT. 106 CULVERT CROSSING

FROM THE RATING CURVE OF RT. 106 CULVER (SEE APPENDIX D - P. D-23)

AT Q = 7678 CFS ⇒ ELEV. = 14.2'
ANTECEDENT DISCHARGE = 0.5'

RISE OF WATER ELEV. DUE TO SARGENT LAKE DAM BREACH = 14.2' - 0.5 = 13.7'
BREACH WOULD OVERTOP THE ROAD BY 4.2'

REACH #2 TYPICAL CROSS SECTION FROM 600' TO 4100' D/S OF RT. 106.

FROM THE RATING CURVE OF REACH #2 (SEE APPENDIX D - P. D-25)

AT Q = 7678 CFS ⇒ ELEV. = 12.8'

RISE OF WATER ELEV. DUE TO SARGENT LAKE DAM BREACH = 12.8' - 0.5 = 12.3'

HURRICANE Rd. CULVERT

FROM THE RATING CURVE OF HURRICANE Rd. CULVERT (SEE APPENDIX D - P. D-27)

AT Q = 7678 ⇒ E/EV. = 14.8'

ANTECEDENT DISCHARGE = 0.5'

RISE OF WATER E/EV. DUE TO SARGENT LAKE DAM BREACH

14.8' - 0.5' = 14.3'

REACH #3 TYPICAL SECTION FROM 4100' TO 5100' D/S

FROM THE RATING CURVE OF REACH #3 (SEE APP. D - P. D-29)

AT Q = 7678 CFS E/EV. = 10.1',

ANTECEDENT DISCHARGE = 0.5'

RISE OF WATER E/EV. DUE TO SARGENT LAKE DAM BREACH:

10.1' - 0.5' = 9.6'

STATE RT. 140

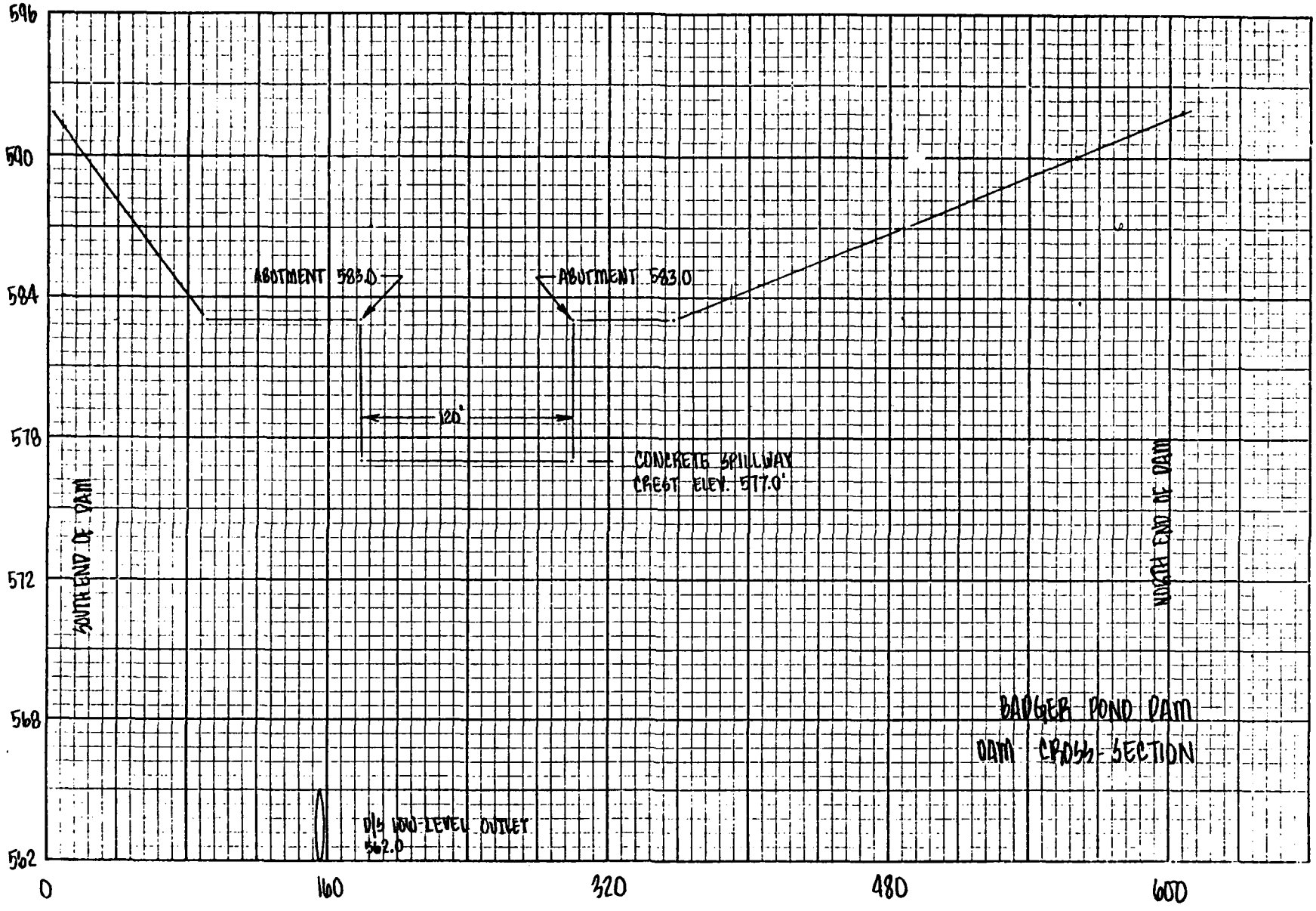
FROM RATING CURVE OF RT. 140 (SEE APP. D-P. D-31)

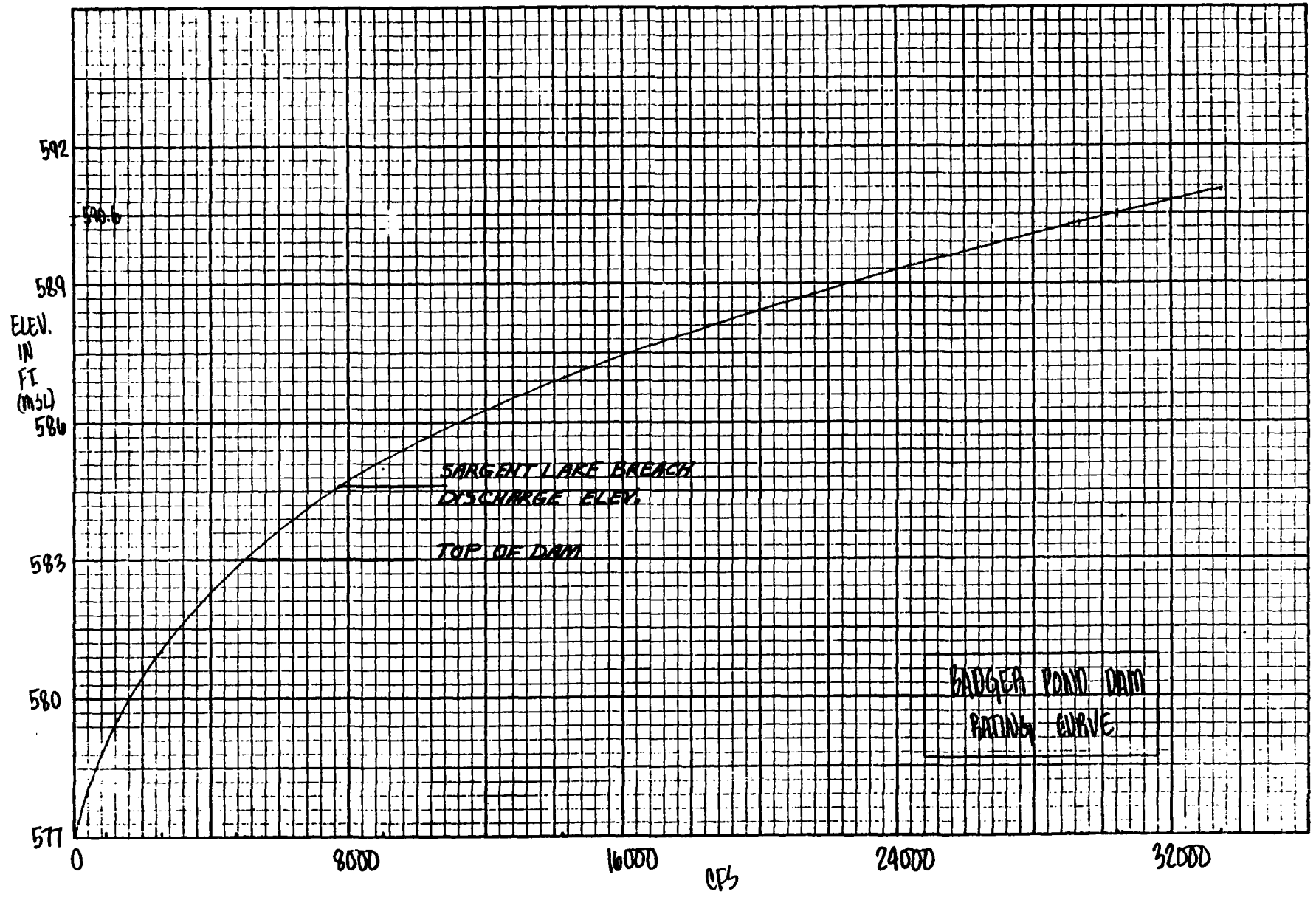
AT Q = 7678 CFS ⇒ ELEV. = 9.5'

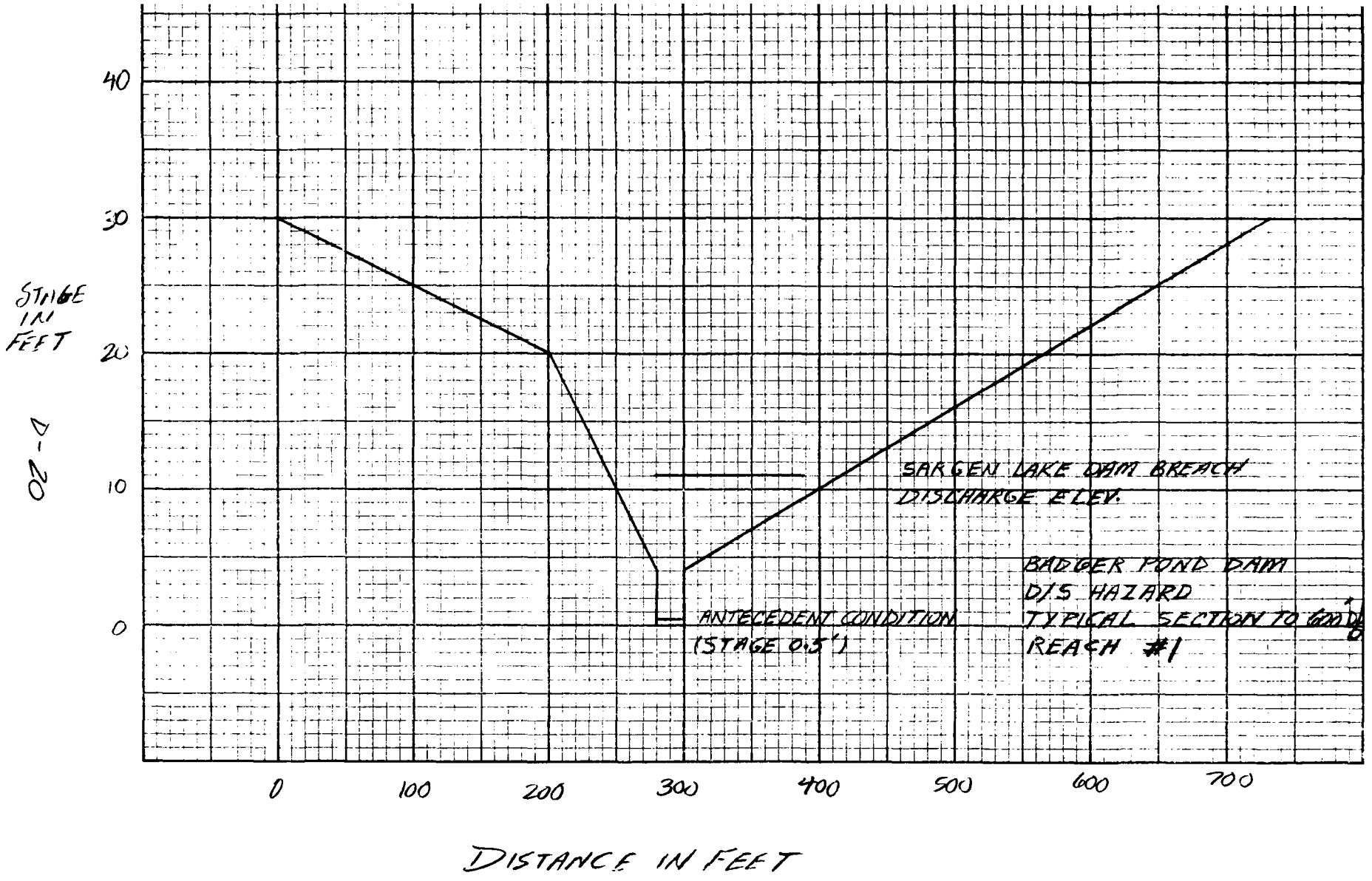
ANTECEDENT CONDITION = 0.5'

RISE IN WATER ELEV. DUE TO SARGENT LAKE DAM BREACH:

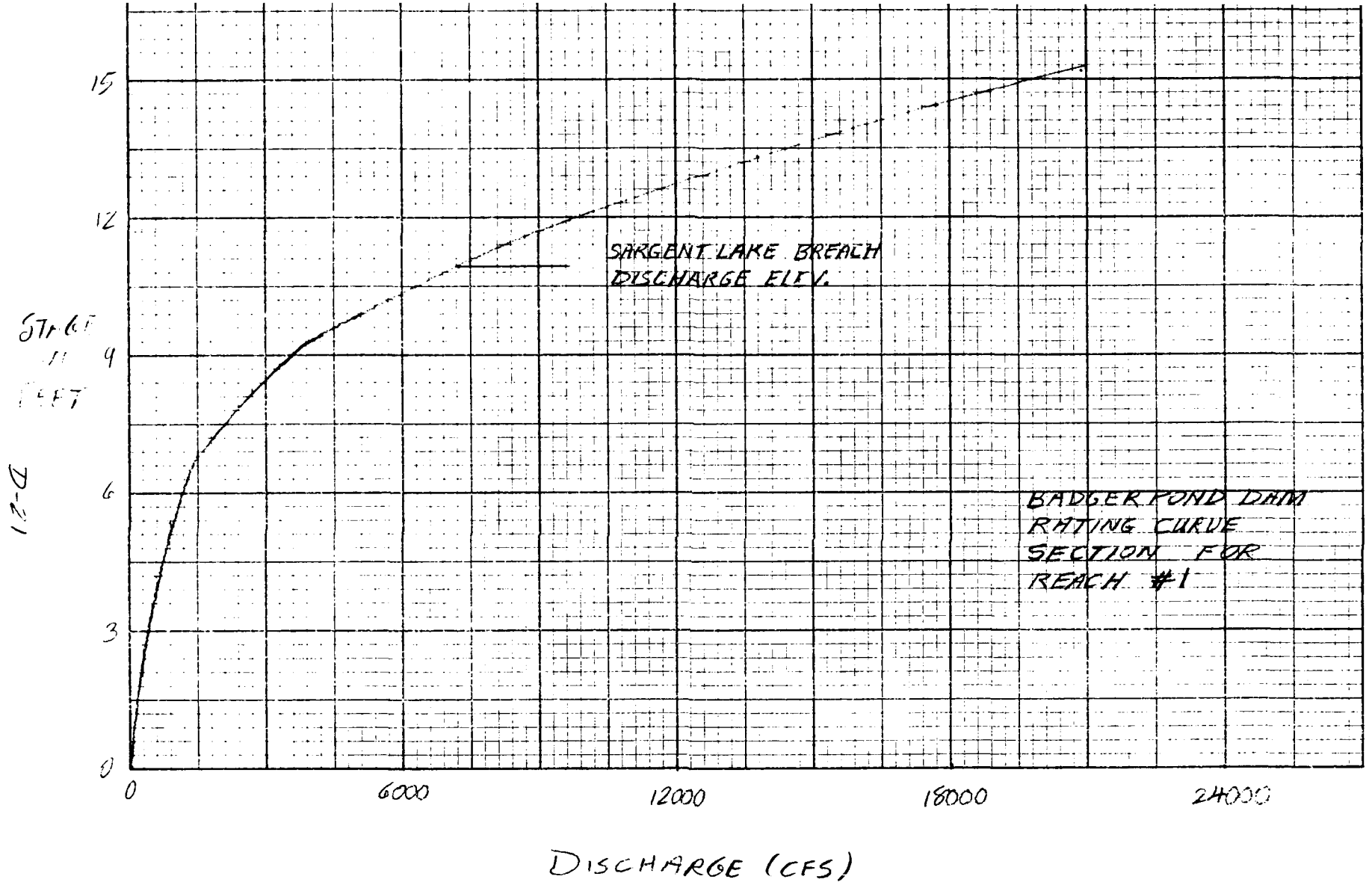
9.5' − 0.5' = 9.0'

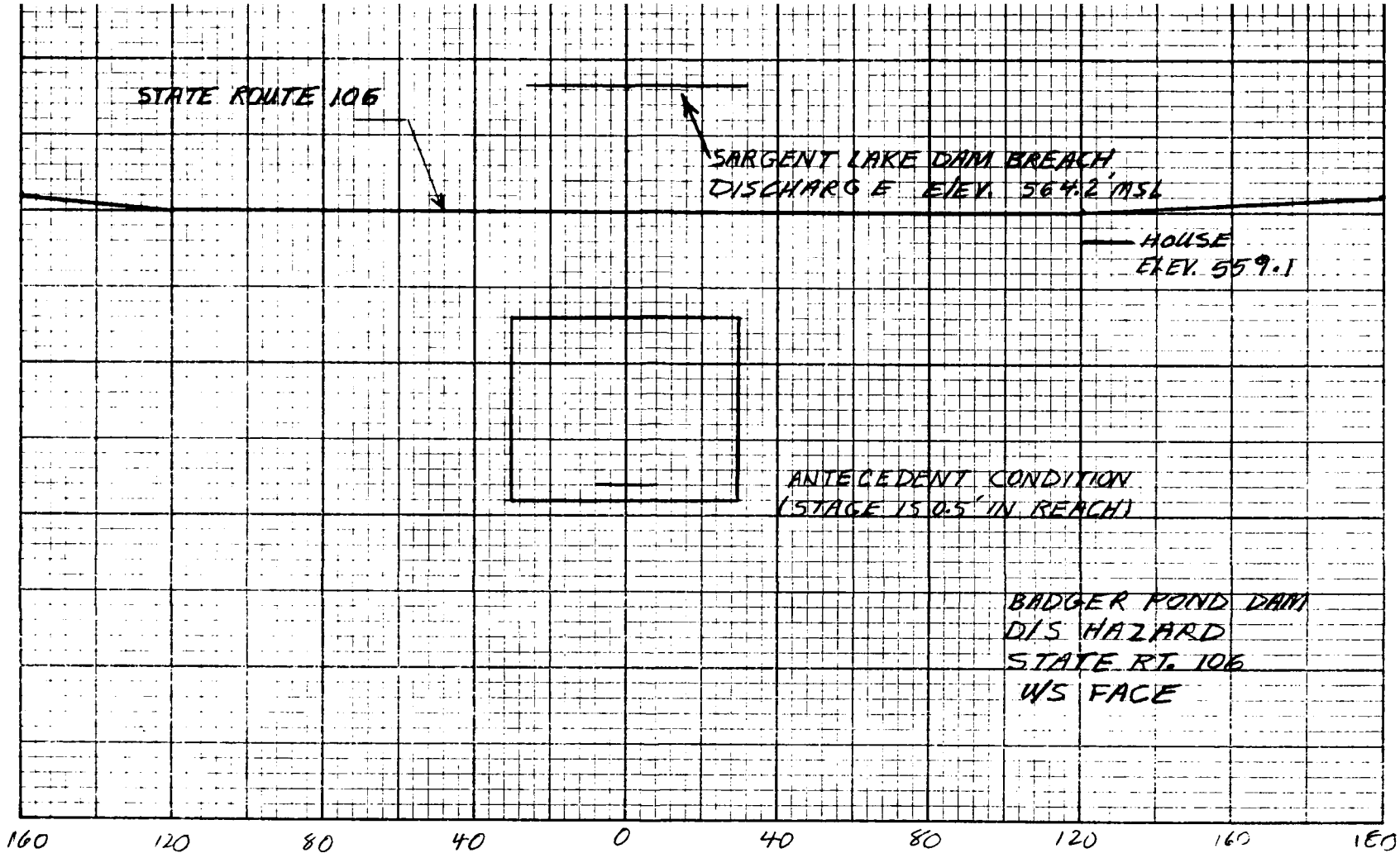

596
590
584
578
572
568
562
0
160
320
480
600
ABUTMENT 583.0
ABUTMENT 583.0
120'
CONCRETE SPILLWAY
CREST ELEV. 577.0'
SOUTH END OF DAM
NORTH END OF DAM
D/S LOW-LEVEL OUTLET
562.0
BADGER POND DAM
DAM CROSS-SECTION


592
590.6
589
ELEV. IN FT (MSL)
586
583
580
577
0
8000
16000
24000
32000
CFS
SARGENT LAKE BREACH DISCHARGE ELEV.
TOP OF DAM
BADGER POND DAM RATING CURVE

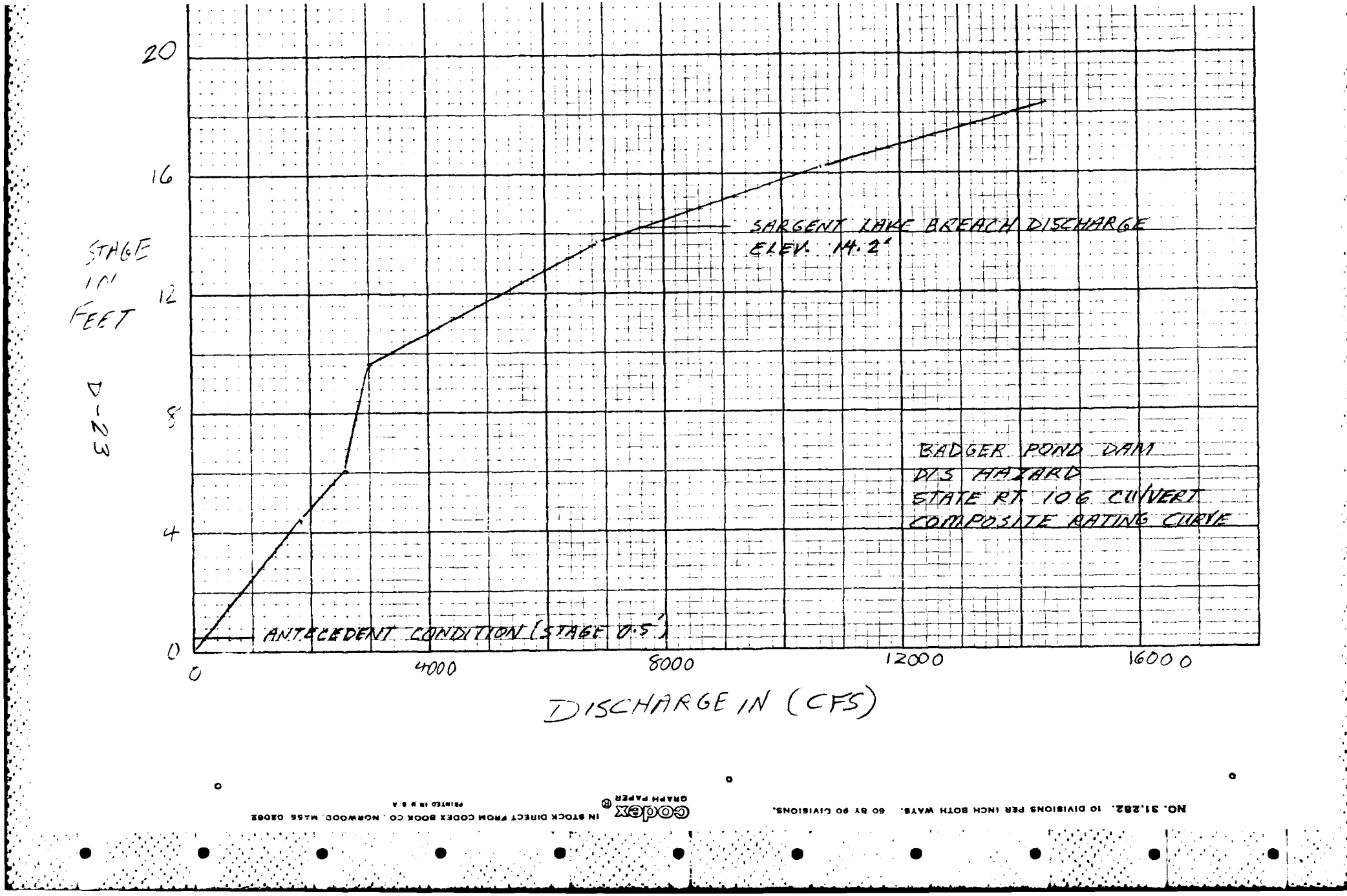


D-20





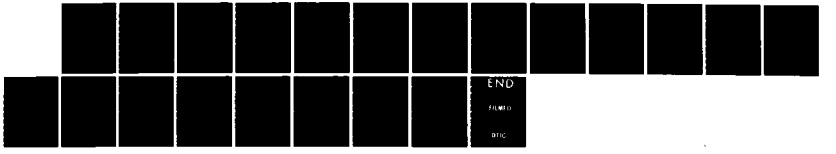
D-22

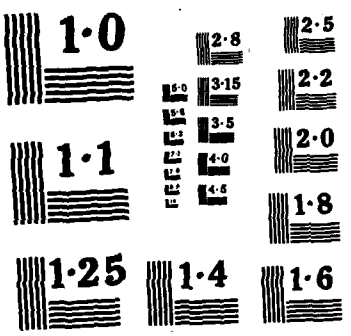


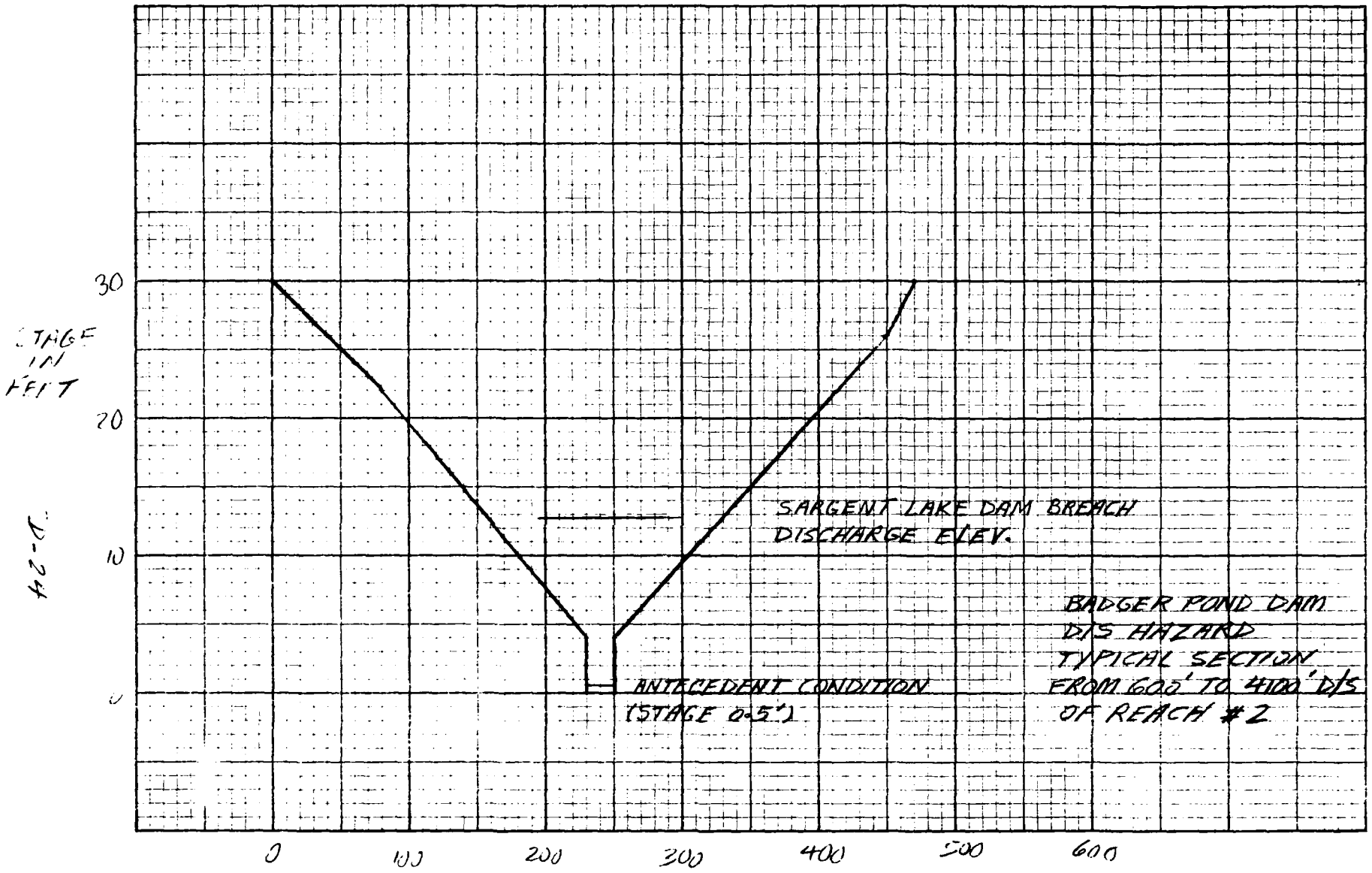
D-23

AD-A156 183 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS 2/2
SARGENT LAKE DAM (NH.. (U) CORPS OF ENGINEERS WALTHAM MA
NEW ENGLAND DIV NOV 79

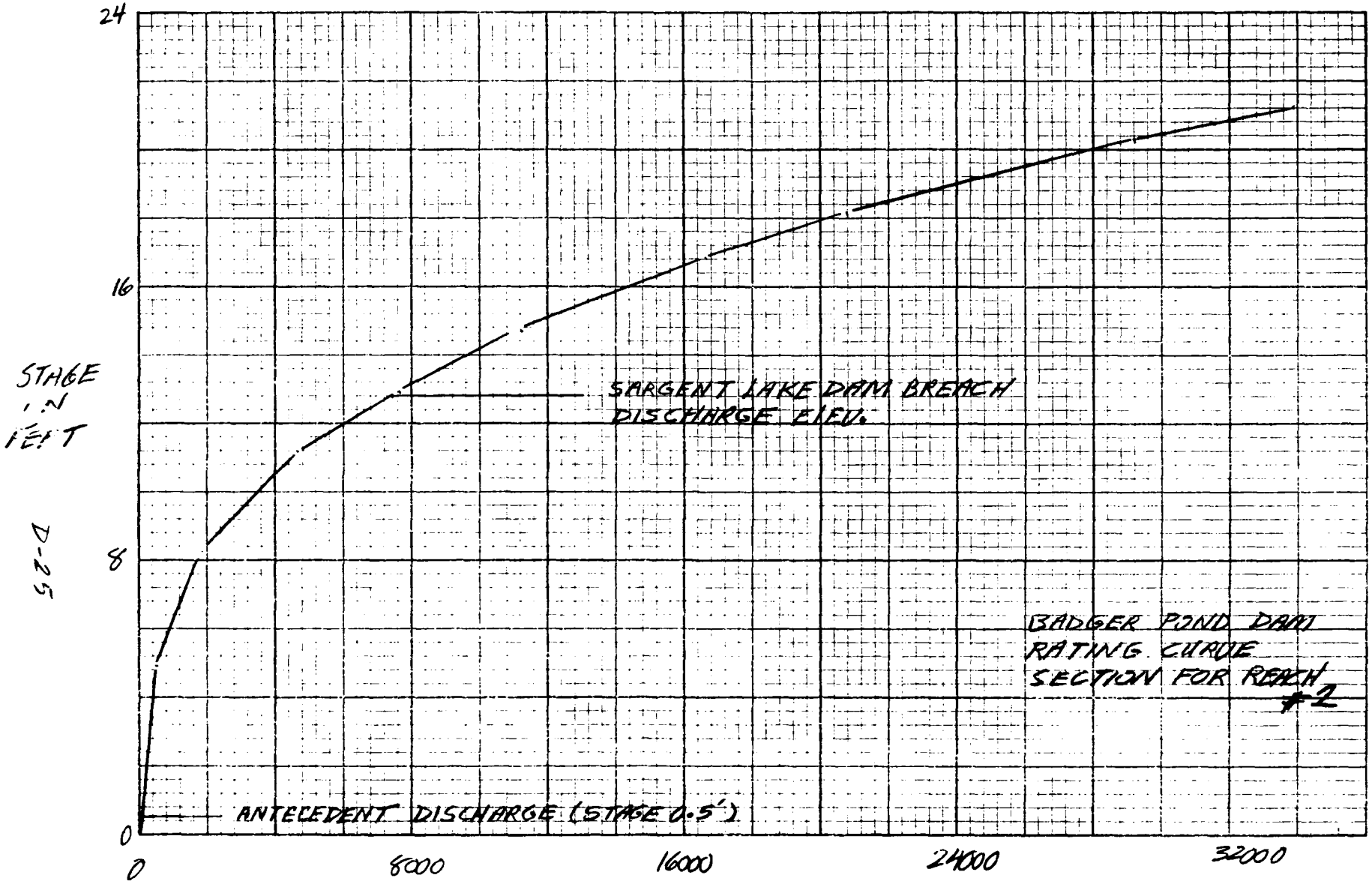
UNCLASSIFIED F/G 13/13 NL

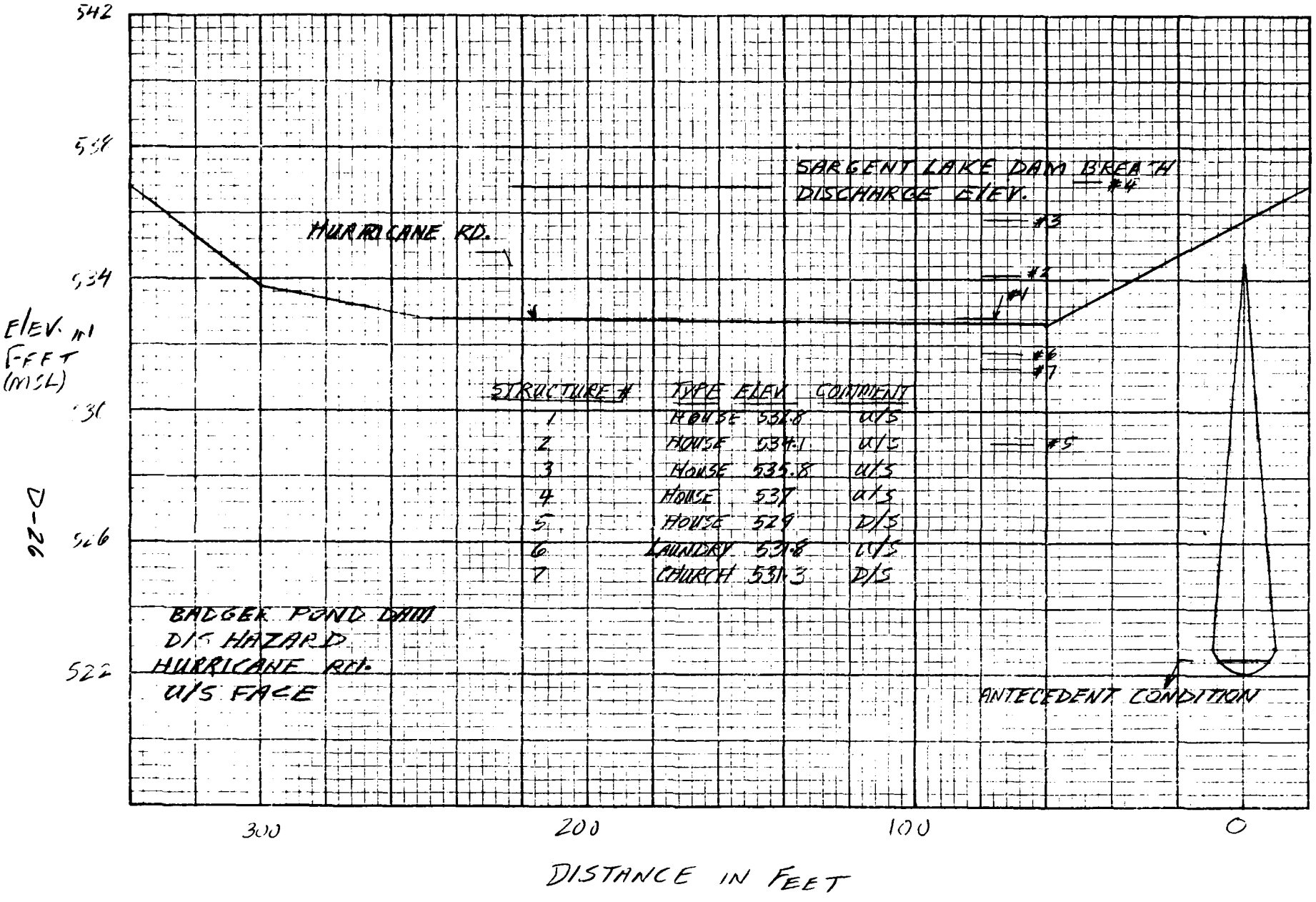






A2-24





D-26

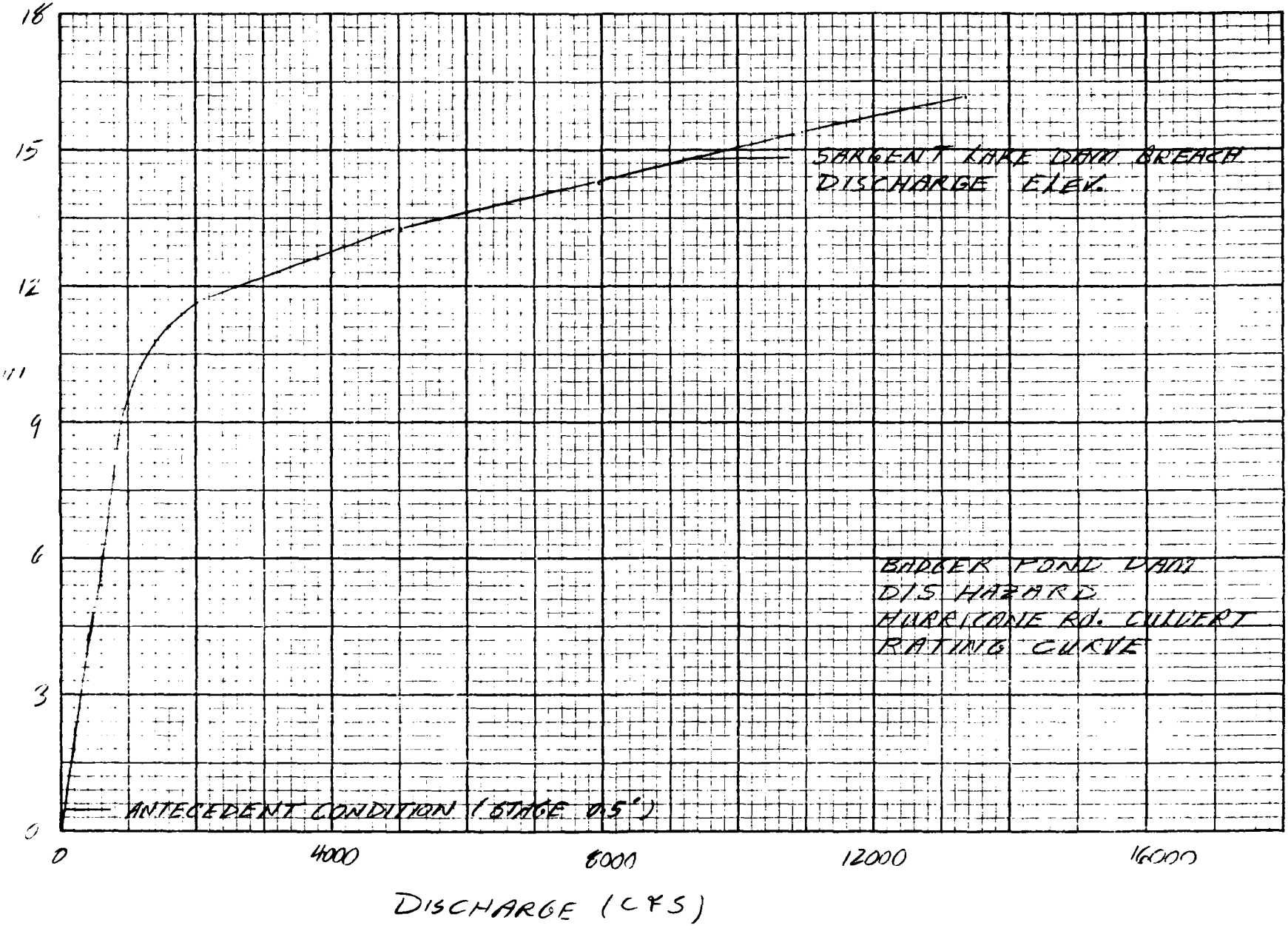
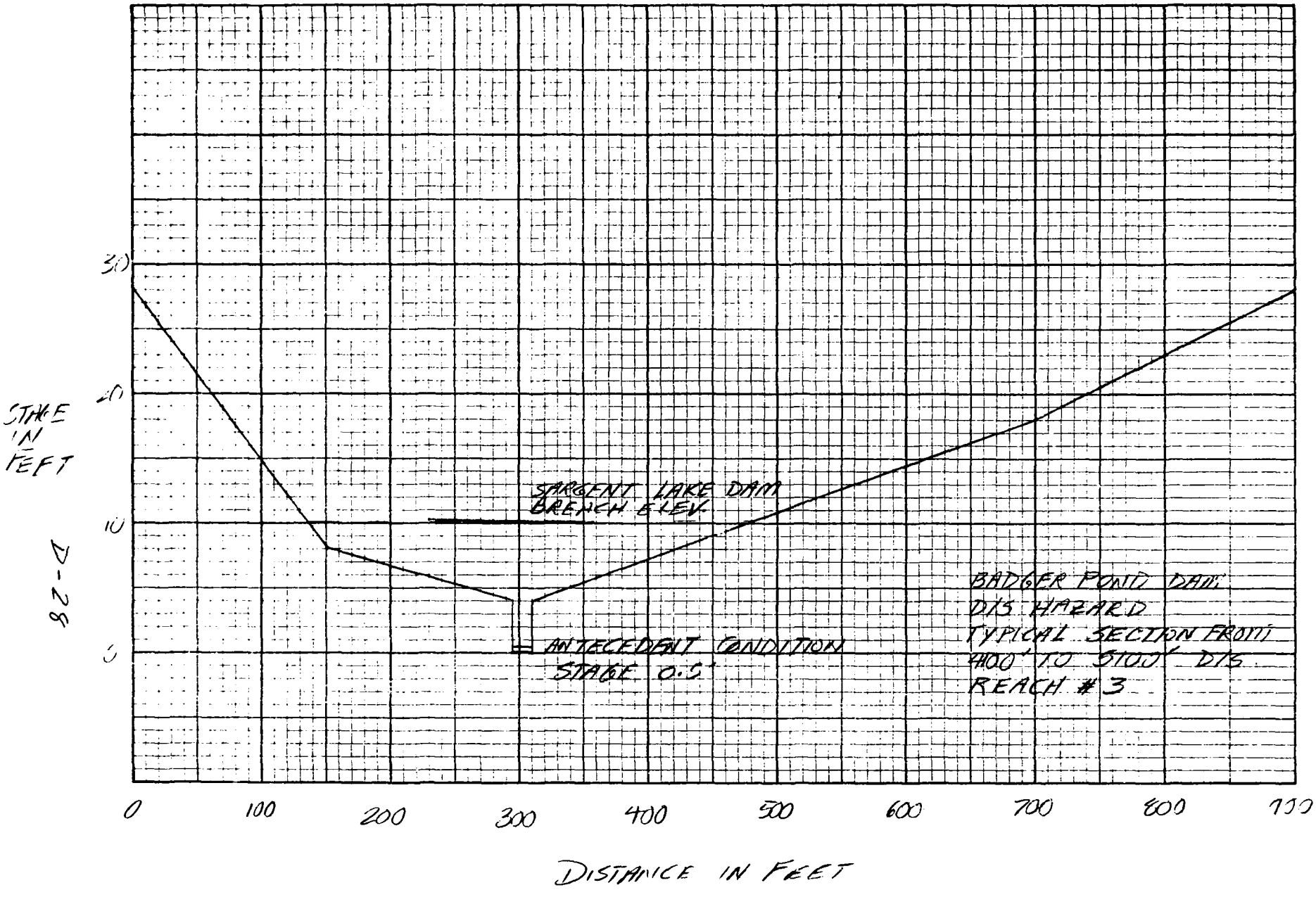
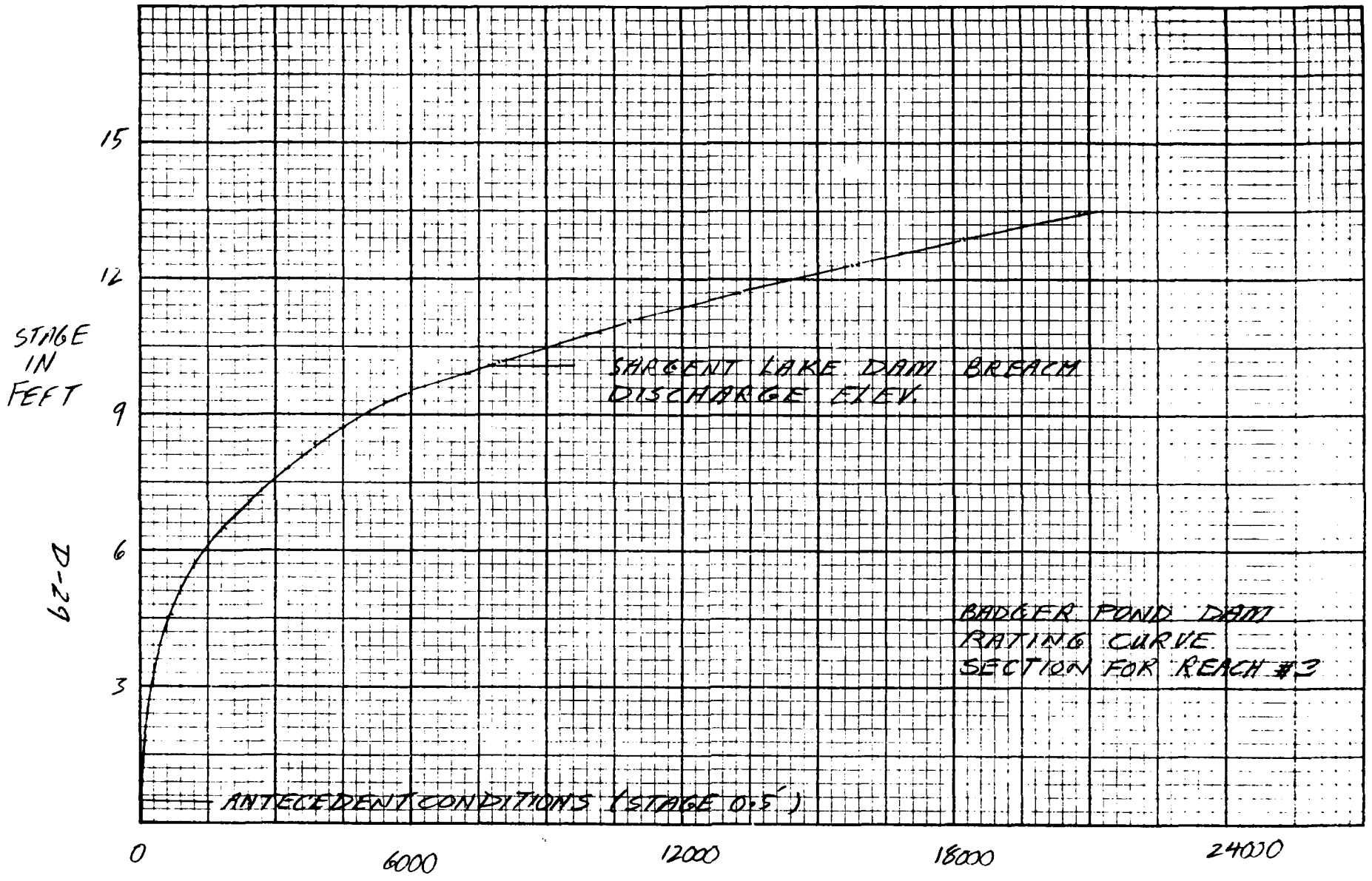


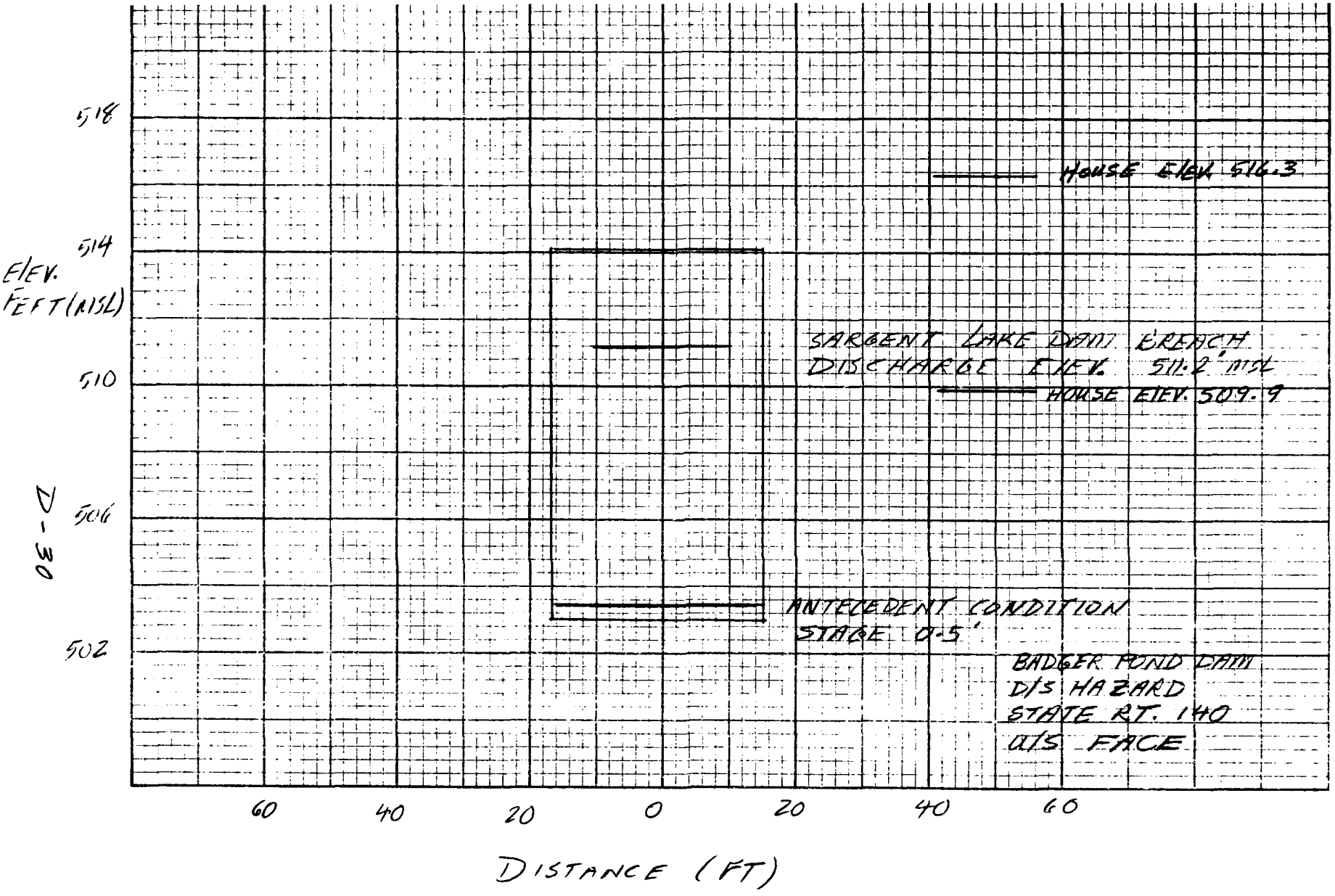
FIGURE
STAGE

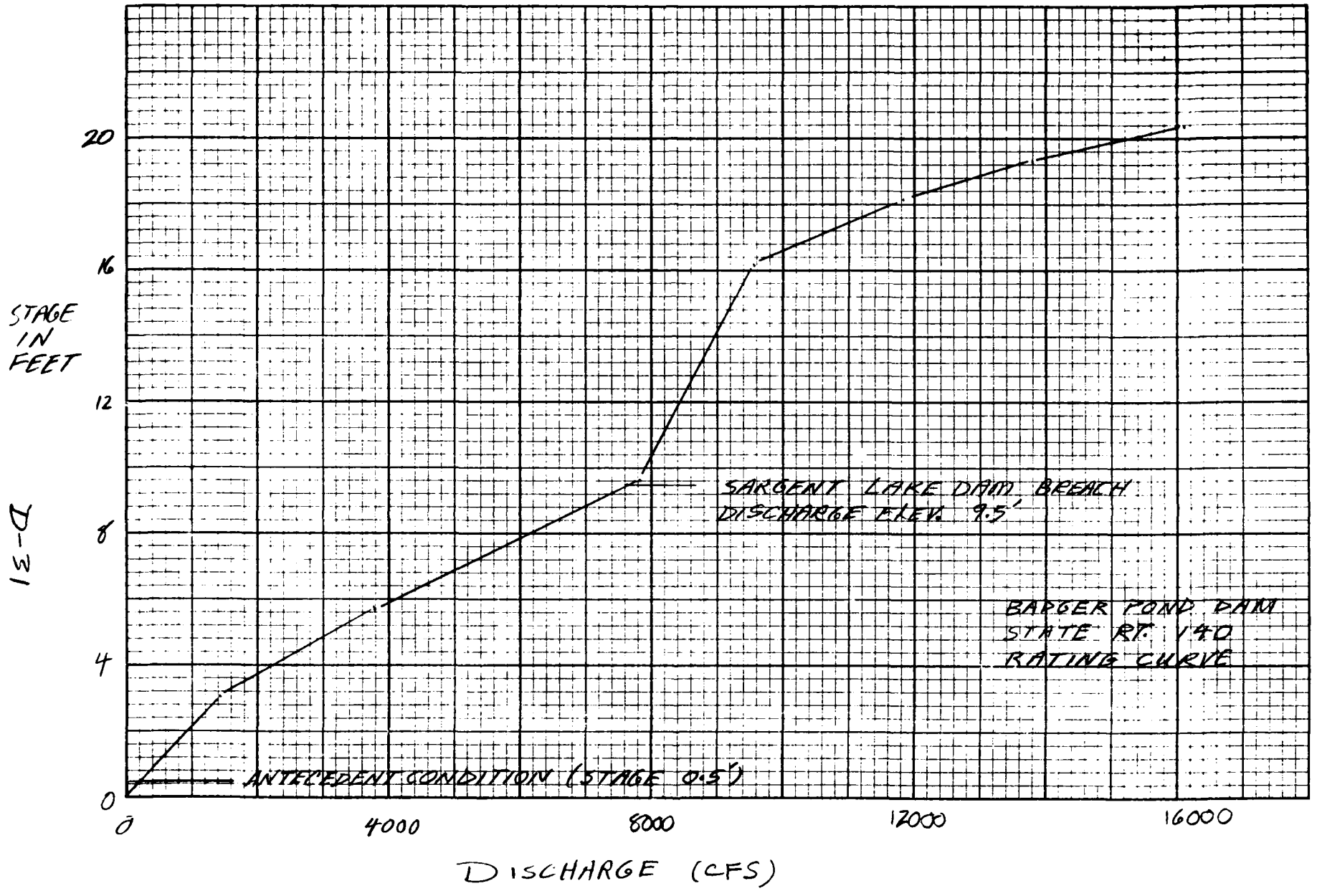
D-27



D-28







D-31

DRAINAGE AREA = 1.3 Mi^2
SIZE CLASSIFICATION = SMALL
HAZARD CLASSIFICATION = HIGH
TEST FLOOD = ½ PMF TO PMF

CALCULATE PMF USING "PRELIMINARY GUIDANCE FOR ESTIMATING MAXIMUM PROBABLE DISCHARGES IN PHASE I DAM SAFETY INSPECTION, MARCH, 1978"

DETERMINE AVERAGE SLOPE OF WATERSHED:
(1200' MSL − 764' MSL) = 436'
APPROX. DISTANCE BETWEEN POINTS = 1.5 MILE
SLOPE = $\frac{436}{1.5}$ = 290 FT/Mi

MOUNTAINOUS CURVE WAS USED TO DETERMINE THE CSM VALUE FOR PMF.
AT DA = 1.3 Mi^2 ⟹ CSM = 2550
PMF = 2550 CSM X 1.3 Mi^2 = 3300 CFS
TEST FLOOD (PMF) = 3300 CFS
SAWYER LAKE (PMF) INFLOW INTO SARGENT LAKE = 2900 CFS

TOTAL TEST FLOOD INFLOW = 3300 + 2900 = 6200 CFS

DEVELOP A DAM DISCHARGE RATING CURVE USING THE WEIR CROSS SECTION SHOWN ON PAGE D-35.

ichols & Company, Inc. Subject H & H

Sheet No. _____ of _____
Date _____
Computed _____
Checked _____

IO.

DETERMINE A SURCHARGE HEIGHT TO PASS "QR" OF 6200 CFS
USE WEIR EQUATION

$$Q = CLH^{3/2}$$

* C = 3.5 FOR 2" THICK STOPLOGS
C = 2.6 FOR WOODED EMBANKMENT
C = 2.7 FOR 10.7' WIDE SPILLWAY, 6' WIDE STONE MASONRY, AND 10' WIDE HOLLOW IN LEFT EMBANKMENT.

ASSUME TOP OF RIGHT ABUTMENT ELEV. = 769' MSL
ASSUME STOPLOG OPENING WITH STOPLOGS

IAL NO.	WATER SURFACE ELEV. (FT MSL)	DISCHARGE (CFS)
1	764.5	$Q = 3.5(2)(.6)^{3/2} = 3.2$
2	764.7	$Q = 3.5(2)(.8)^{3/2} = 5$
3	765.9	$Q = 3.5(2)(2)^{3/2} + 2.7(47)(1.2)^{3/2} = 187$
4	766.5	$Q = 3.5(2)(2.6)^{3/2} + 2.7(47)(1.8)^{3/2} + 2.7(23)(.6)^{3/2} = 364$
5	768.2	$Q = 3.5(2)(5.1)^{3/2} + 2.7(47)(3.5)^{3/2} + 2.7(40)(1.7)^{3/2} + (2.7)(23)(2.3)^{3/2} = 1380$
6	769	$Q = 3.5(2)(5.1)^{3/2} + 2.7(47)(4.3)^{3/2} + 2.7(23)(3.1)^{3/2} + 2.7(40)(2.5)^{3/2} + 2.6(40)(.8)^{3/2} + 2.6(\frac{1}{2})(3.2)(.8)^{3/2} = 2055$
7	770	$Q = 2.7(96)(\frac{1}{2})(1)^{3/2} + 2.7(24)(1)^{3/2} + 3.5(2)(6.1)^{3/2} + 2.7(17)(5.3)^{3/2} + 2.7(40)(3.5)^{3/2} + 2.7(23)(4.1)^{3/2} + 2.6(40)(1.8)^{3/2} + 2.6(\frac{1}{2})(7.2)(1.8)^{3/2} = 3345$
8	771.8	$Q = 2.7(96)(\frac{1}{2})(1)^{3/2} + 2.7(96)(1.8)^{3/2} + 2.7(24)(2.8)^{3/2} + 3.5(2)(7.9)^{3/2} + 2.7(47)(7.1)^{3/2} + 2.7(40)(5.3)^{3/2} + 2.7(23)(5.9)^{3/2} + 2.6(40)(3.6)^{3/2} + 2.6(\frac{1}{2})(14.4)(3.6)^{3/2} = 6665$

+ C VALUES WERE TAKEN FROM BRATER & KING HANDBOOK OF HYDRAULICS

Nichols & Company, Inc.

Subject H & H
SARGENT LAKE

Sheet No. ____ of ____
Date ____
Computed ____
Checked ____

JOB NO.

ASSUME STOPLOG OPENING WITHOUT STOPLOGS :

TRIAL NO.	WATER SURFACE ELEV. FT MSL	DISCHARGE (CFS)
1	764.5	$Q = 2.7(2)(1.9)^{3/2} = 14$
2	764.7	$Q = 2.7(2)(2.1)^{3/2} = 16.5$
3	765.9	$Q = 2.7(2)(3.3)^{3/2} + 2.7(47)(1.2)^{3/2} = 199$
4	766.5	$Q = (2.7)(2)(3.9)^{3/2} + 2.7(47)(1.8)^{3/2} + 2.7(23)(.6)^{3/2} = 376$
5	768.2	$Q = 2.7(2)(6.4)^{3/2} + 2.7(47)(3.5)^{3/2} + 2.7(40)(1.7)^{3/2} + 2.7(23)(2.3)^{3/2} = 1374$
6	769	$Q = 2.7(2)(6.4)^{3/2} + 2.7(47)(4.3)^{3/2} + 2.7(23)(3.1)^{3/2} + 2.7(40)(2.5)^{3/2} + 2.6(40)(.8)^{3/2} + 2.6(\frac{1}{2})(3.2)(.8)^{3/2} = 2061$
7	770	$Q = 2.6(96)(\frac{1}{2})(1)^{3/2} + 2.7(24)(1)^{3/2} + 2.7(2)(7.4)^{3/2} + 2.7(47)(5.3)^{3/2} + 2.7(40)(3.5)^{3/2} + 2.7(23)(4.1)^{3/2} + 2.6(40)(1.8)^{3/2} + 2.6(\frac{1}{2})(7.2)(1.8)^{3/2} = 3344$
8	771.8	$Q = 2.6(96)(\frac{1}{2})(1)^{3/2} + 2.6(96)(1.8)^{3/2} + 2.7(24)(2.8)^{3/2} + 2.7(2)(9.2)^{3/2} + 2.7(47)(7.1)^{3/2} + 2.7(40)(5.3)^{3/2} + 2.7(23)(5.9)^{3/2} + 2.6(40)(3.6)^{3/2} + 2.6(\frac{1}{2})(14.4)(3.6)^{3/2} = 6630$

TOTAL TEST FLOOD INFLOW = 6200 CFS

REFER TO RATING CURVE ON PAGE

AT $Q = 6200$ CFS $\Rightarrow$ ELEV. = 771.6' MSL

ELEV. TOP OF THE DAM = 765.9 MSL

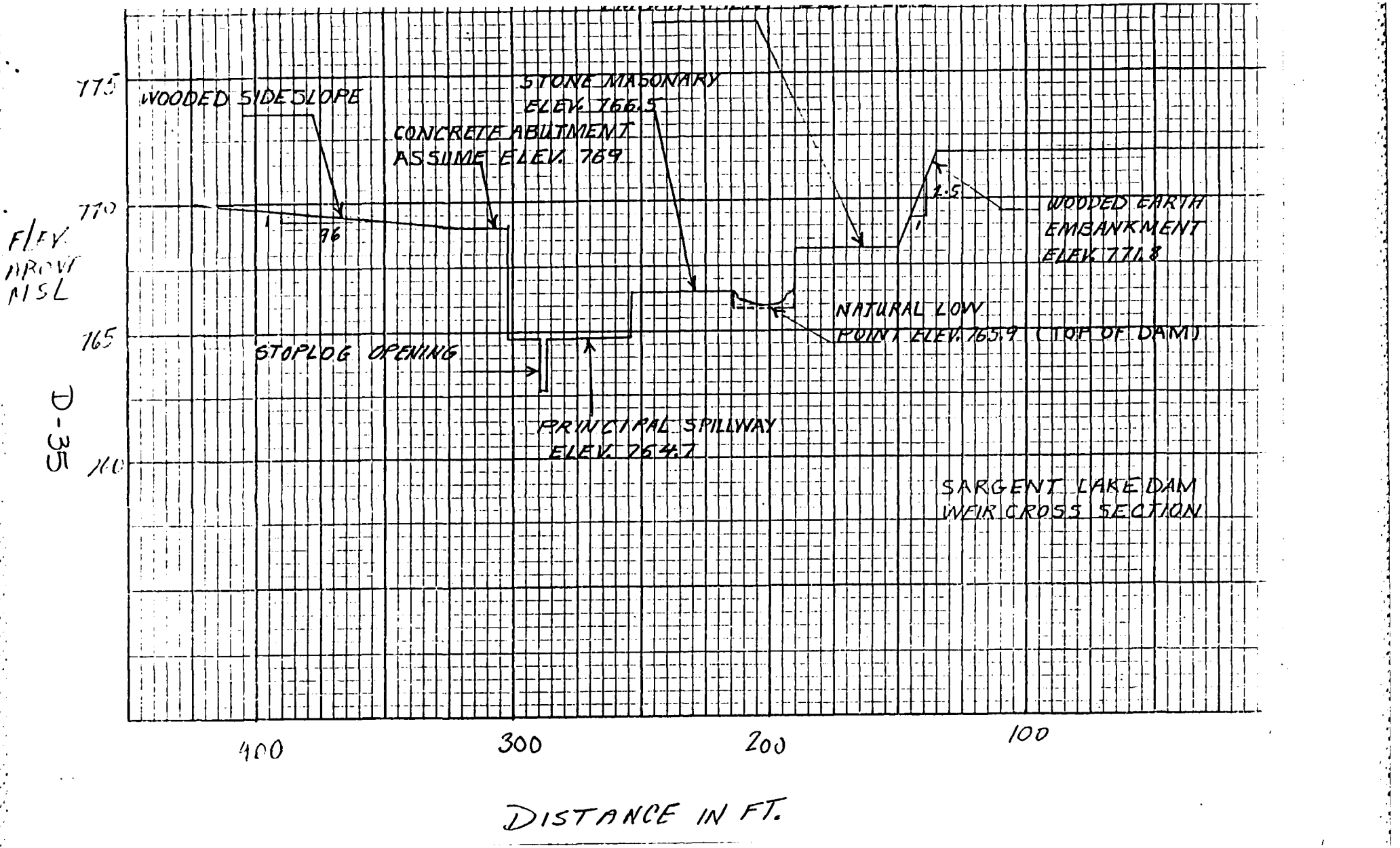
THE DEPTH OF WATER OVER SPILLWAY CREST DURING PMF WILL APPROXIMATELY BE :

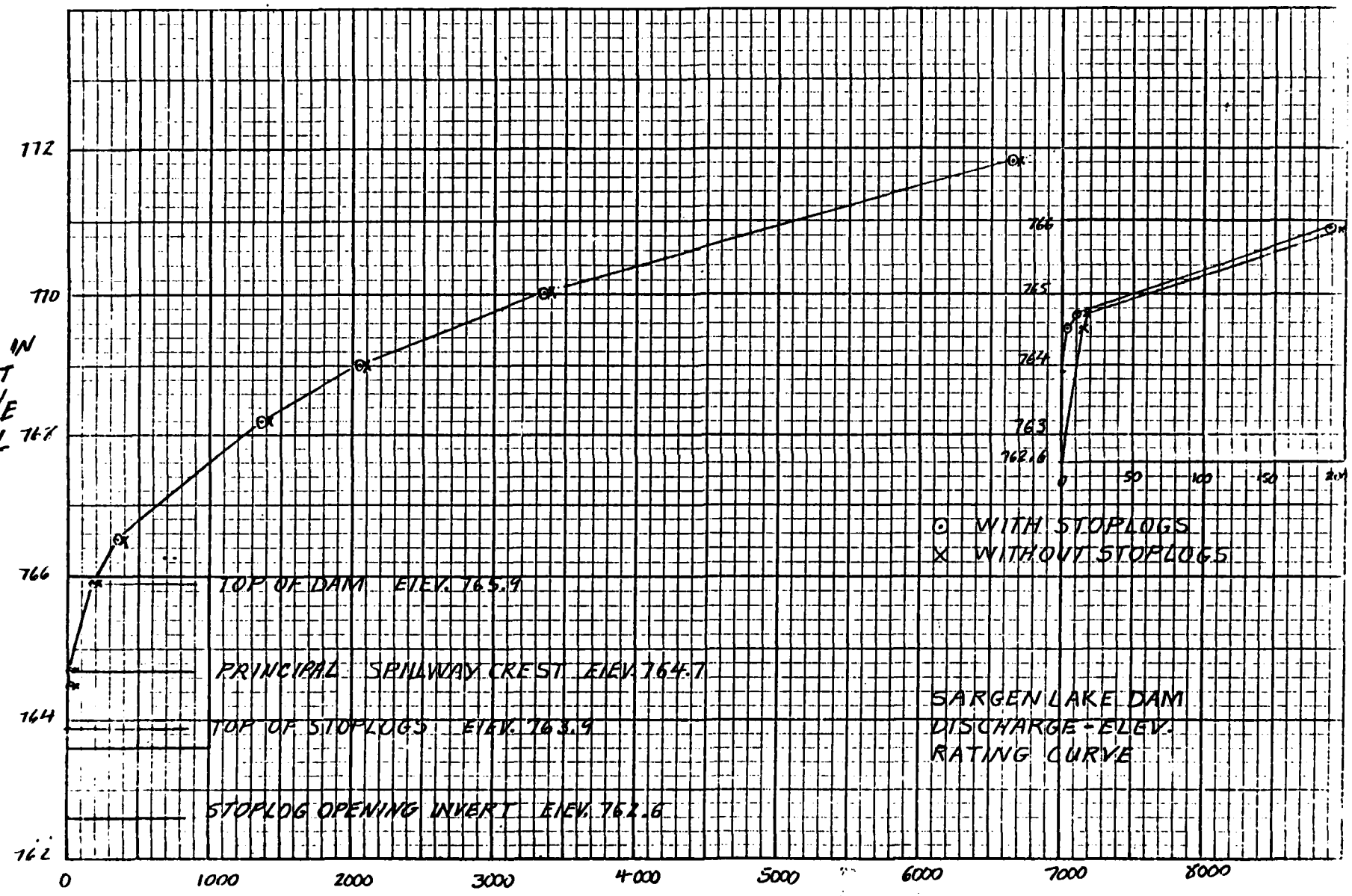
771.6 − 764.7 = 6.9 FEET

THE DAM WILL BE OVERTOPPED BY

771.6 − 765.9 = 5.5 FEET

DURING PMF


775
770
765
760
ELEV. ABOVE MSL
WOODED SIDESLOPE
1
96
CONCRETE ABUTMENT
ASSUME ELEV. 769
STONE MASONARY
ELEV. 766.5
STOPLOG OPENING
PRINCIPAL SPILLWAY
ELEV. 764.7
NATURAL LOW
POINT ELEV. 765.9 (TOP OF DAM)
2.5
1
WOODED EARTH
EMBANKMENT
ELEV. 771.8
SARGENT LAKE DAM
WEIR CROSS SECTION
400
300
200
100
DISTANCE IN FT.



ELEV. IN FEET ABOVE MSL

DISCHARGE IN CFS

DETERMINE VOLUME OF SURCHARGE IN INCHES OF RUNOFF.

NORMAL POOL ELEV. = 764.7' MSL

FROM U.S.G.S. QUAD SHEET:

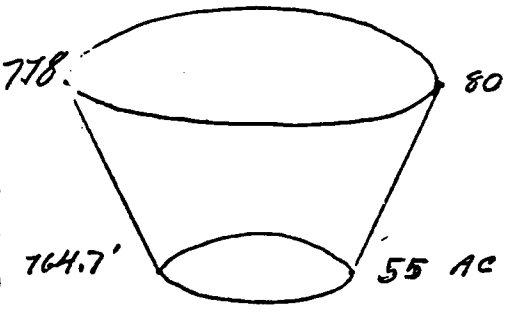
SURFACE AREA AT NORMAL POOL = 55 AC
NORMAL POOL STORAGE = 360 AC-FT

USING FRUSTRUM OF PYRAMID EQUATION

$$V = \frac{1}{3} h \left(b_1 + b_2 + \sqrt{b_1 b_2} \right)$$

WHERE

h = ELEV. ABOVE NORMAL POOL
b_1 = NORMAL POOL SURFACE AREA (AC)
b_2 = ENLARGED SURFACE AREA (AC)



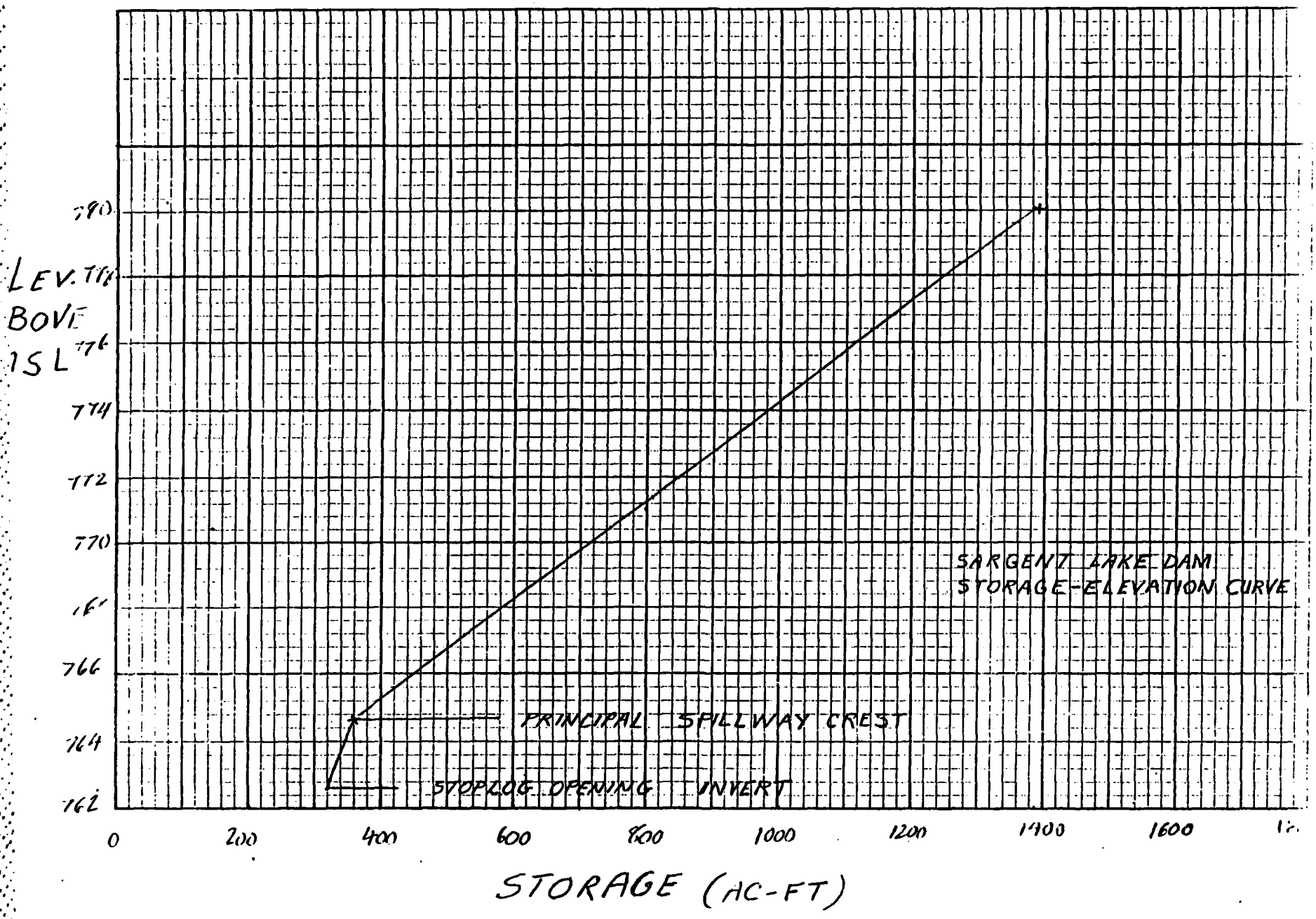
AT ELEV. 778' MSL ⇒ *SURFACE AREA = 80 AC

$$V = \frac{1}{3}(15.3)(55+80+\sqrt{55 \times 80}) = 1030 \text{ AC-FT}$$

TOTAL STORAGE = 1030 + 360 = 1390 AC-FT

USE ABOVE DATA TO DEVELOP STORAGE VS. ELEV. CURVE.

* SURFACE AREAS WERE PLANIMETERED FROM U.S.G.S. QUAD SHEET.


LEV. FT ABOVE ISL
780
776
774
772
770
768
766
764
762
0
200
400
600
800
1000
1200
1400
1600
STORAGE (AC-FT)
SARGENT LAKE DAM
STORAGE-ELEVATION CURVE
PRINCIPAL SPILLWAY CREST
STOPLOG OPENING INVERT

Anderson-Nichols & Company, Inc.

Subject H & H
SARGENT LAKE

Sheet No. ____ of ____
Date ____
Computed AAA
Checked ____

JOB NO.

AT ELEV. 771.6' MSL (TEST FLOOD ELEV.) ⇒ STORAGE = 820 AC-FT
NORMAL STORAGE = 360 AC-FT
SURCHARGE STORAGE = 820 − 360 = 460 AC-FT

$$460 \text{ AC-FT} \times \frac{1}{2.8 \text{ MI}^2} \times \frac{1 \text{ MI}^2}{640 \text{ AC}} = 0.26' = 3.08''$$

$$QP_2 = QP_1 \left(1 - \frac{STOR_1}{19''}\right)$$

WHERE QP_1 = TOTAL TEST FLOOD INFLOW

$$QP_2 = 6200 \left(1 - \frac{3.08}{19}\right) = 5200 \text{ CFS}$$

DETERMINE SURCHARGE HEIGHT TO PASS QP_2 OF 4050 CFS

REFER TO RATING CURVE (P.D-36)

AT 5200 CFS ⇒ ELEV. = 771 'MSL

REFER TO STORAGE-ELEV. CURVE (P.D-38)

AT 771 'MSL ⇒ STORAGE - 785 AC-FT

$$(785 - 360) \text{ AC-FT} \times \frac{1}{2.8 \text{ MI}^2} \times \frac{1 \text{ MI}^2}{640 \text{ AC}} = 0.24' = 2.85''$$

$STOR_1 = 3.08''$
$STOR_2 = 2.85''$
AVERAGE = 2.97" = 0.25'

$$(0.25') \left(\frac{2.8 \text{ MI}^2}{1}\right) \left(\frac{640 \text{ AC}}{1 \text{ MI}^2}\right) = 448 \text{ AC-FT}$$

448 + 360 = 808 AC-FT
ELEV. = 771.4 'MSL (FROM STORAGE-ELEV. CURVE P.D-38)
FROM RATING CURVE PAGE D-36 AT ELEV. 771.4'

TEST FLOOD DISCHARGE = 5850 CFS

NORMAL STORAGE = 360 AC-FT
MAXIMUM STORAGE = 440 AC-FT

Anderson-Nichols & Company, Inc.

Subject _____

Sheet No. _____ of _____
Date _____
Computed _____
Checked _____

JOB NO.

SQUARES 1/4 IN. SCALE

EMERGENT LAKE DAM LOW LEVEL OUTLET CAPACITY

OUTLET DIMENSIONS = 2' x 3.5'
INVERT ELEVATION = 752.2' MSL
AREA = 2' x 3.5' = 7 FT²

CALCULATE CAPACITY AT SPILLWAY ELEVATION 764.7' MSL
USING ORIFICE EQUATION:

$$Q = C A \sqrt{2gh}$$

WHERE $h = 764.7' - 753.2' = 11.5'$
$A = 7 FT^2$
*$C = 0.84$

$$Q = (0.84)(7 FT^2)(\sqrt{2 \times 32.2 \times 11.5}) = 160 \text{ CFS}$$

* C VALUE WAS OBTAINED USING KING & BRATER "HANDBOOK OF HYDRAULICS" (P. 4-38, TABLE 4-11)

CALCULATION OF THE TIME REQUIRED TO DRAIN THE SARGENT LAKE DAM USING 2'x3.5' LOW LEVEL OUTLET.

USE "D.C. NOONAN'S MEMO DRAWDOWN CAPACITY WITH FALLING HEAD" AS A GUIDE;

ASSUMPTIONS:

1- THERE IS NO INFLOW DURING DRAWDOWN DURATION

2- SURFACE AREA VS. HEAD CAN BE EXPRESSED AS LINEAR RELATIONSHIP

3- OUTFLOW CAN BE CALCULATED USING THE ORIFICE EQUATION

$$Q_o = C A_o \sqrt{2gh}$$

WHERE $C = 0.84$ (From King & Brater Handbook of Hydraulics)

FROM D.C. NOONAN'S MEMO

$$t = \frac{K}{C A_o \sqrt{2g}} \left[-\frac{2}{3} h^{3/2} \right]_{h_1}^{h_2}$$

WHERE

h_1 = HEAD AT NORMAL POOL = 11.5'

h_2 = 0' LAKE DRAINED

JARES IN. SCALE 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28

GIVEN:

1- 2'X3.5' low level outlet 10.7' in length ($C = 0.84$), INVERT = 752.2' msl ($h = 0$)

2- NORMAL POOL ELEV. = 764.7' msl, $h = 11.5'$

3- SURFACE AREA
AT NORMAL POOL = 55 AC
AT. ELEV. 780 msl = 80 AC $h = 26.8$

4- ORIFICE COEFFICIENT = 0.84

A LINEAR RELATIONSHIP BETWEEN SURFACE AREA & HEAD CAN BE DEFINED

$$\Delta(S.A.) = \frac{(80-50)\,AC}{26.8' - 11.5'} = 2\ \frac{AC}{FT}$$

$$K = \Delta(S.A.) = 2\ \frac{AC}{FT}\left(\frac{43560\ FT^2}{1\ AC}\right) = 87120\ \frac{FT^2}{FT}$$

∴ FOR UNIT CHANGE IN DEPTH A $87120\ FT^2$ CHANGE IN SURFACE AREA WILL OCCUR.

$$t = \frac{87120}{(0.84)(7)\sqrt{2\times 32.2}}\left[-\frac{2}{3}(0)^{2/3} - \left(-\frac{2}{3}(11.5)^{3/2}\right)\right]$$

$t = 47946$ Sec

$T = \underline{13.3}$ hrs.

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

END

FILMED

8-85

DTIC